Test & Measurement Catalog

1994

Oscilloscopes • ScopeMeter Test Tools • Multimeters & Voltmeters • Counters & Timer/Counters • Data Acquisition
Digital Thermometers • LAN Products • Calibrators & Standards • Logic Analyzers • Digital Test Tools
Instrumentation Systems • Power Supplies • Signal Sources • Video & Audio Test Equipment • Accessories • Support Services

mV
M
μF
Hz
250μs
LoZ

FLUKE®

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Fluke and Philips – The Global Alliance In Test and Measurement

FLUKE®

Contents

1 Introduction
2 Oscilloscopes
3 ScopeMeter Test Tools
4 System & Bench Multimeters
5 RCL Meters
6 Handheld Multimeters
7 Multimeter Accessories
8 Counters & Timer/Counters
9 Data Acquisition
10 Digital Thermometers
11 LAN Products
12 Calibration Instruments
13 Logic Analyzers
14 Digital Troubleshooting Tools
15 Instrumentation Systems
16 Power Supplies
17 Signal Sources
18 TV & Video Pattern Generators
19 General Accessories
20 Customer Support Services
21 Glossary
22 Ordering Information

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1994 Fluke
Test & Measurement
Catalog

How to use this Catalog

Your Fluke Catalog is organized into 22 different sections of information, each with its own title and number as shown on the Contents page. For easy referencing, you will find the section titles repeated at the top of each page in the catalog. Also, section numbers are printed on the outer right hand page margins.

Following the introductory overview of new and highlighted Fluke products is a series of page-reference indexes. The first is a general index of the individual product categories contained within each section. Next is an alphabetized functional listing of all products and services in the catalog. The third index is arranged by product number.

Most of the catalog sections begin with a divider page that includes a table of contents for that section, along with pictures of key products featured in that section. Directly following most divider pages is a selection guide that compares key features and specifications of all products in the section, and lists page numbers. Product pages generally begin with a photograph of the product together with a summary listing of key specification and features. Following that is a thorough presentation of the product's features and benefits, together with full technical and general product specifications, and ordering information.

When you have found the product you want, contact your nearest sales office to place your order. Addresses and telephone numbers are listed in the last section of this catalog, and a Call Guide is also included on the inside back cover. If you prefer, you may request additional information by returning the enclosed reply card.

Thank you for considering Fluke products. We hope you find this catalog to be a useful selection guide and ordering tool, and we look forward to the opportunity of working with you.

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LoZ

Five-Year Alliance Culminates in Acquisition of Philips Test & Measurement

The year 1993 marked a major milestone for Fluke: the acquisition of Philips Test & Measurement and a concerted, strategic focus on the growing worldwide market demand for T&M solutions.

Today's electronic equipment creates considerable testing challenges. Miniaturization of components, application-specific integrated circuits, and higher speeds are just a few of these challenges. Over a five-year period, alliance partners Fluke and Philips proved that a focused research and development effort combining the companies' individual strengths could produce definitive new T&M tools for new applications and for specialized markets.

One collaborative effort culminated in the ScopeMeter® test tool—a combined oscilloscope and multimeter. That product was quickly recognized for its innovation, overall value, and deep feature set, and was voted *Best New Product of the Year* by major trade publications.

What does the acquisition mean for Fluke customers? It means that they will benefit from the merging of capabilities and the alignment of both organizations under one dedicated mission.

The concentrated focus makes the combined company more effective in product definition and design. Time-to-market for new products will improve, and customers have the assurance of long-term continuity and product support from one strategically focused company.

Fluke is dedicated to supporting the international marketplace for T&M products.

Fluke's Service Tools and Verfication Tools Division headquarters at Fluke Park, Everett, Washington.

Fluke test tools are designed to facilitate quality work in less time.

Combined capabilities allow more effective product definition and design.

ScopeMeter printed circuit board assembly area in the Almelo manufacturing plant.

Become One

By acquiring Philips Test & Measurement, Fluke combined the strengths of two respected T&M companies. With manufacturing on two continents, 14 subsidiaries in Europe, subsidiaries in Canada, Japan, the Pacific Rim, and representation in over 70 countries, Fluke is better poised than ever to support and serve T&M users around the globe.

As part of the acquisition, Fluke created a new division called Diagnostic Tools, which includes Philips' former European product development and manufacturing operations. This division is headquartered in Almelo, The Netherlands, and has worldwide responsibility for the design, manufacturing and marketing of its respective product lines. Two other divisions, Service Tools and Verification Tools, are headquartered in Everett, Washington, USA. All of these divisions draw on the talents, experience and leadership of all personnel, combining expertise that once was available only in separate units on opposite sides of the world.

Fluke's Diagnostic Tools Division headquarters at Almelo, The Netherlands.

FLUKE IS CERTIFIED BY NQA TO MEET
ISO9001
BS5750 PART1:ISO9001 STANDARDS

Systems for calibration are part of Fluke's ISO 9001 quality assurance program.

Fluke tools are compact enough to be taken directly to the point where they can do the most good.

With the new organization, Fluke is better able to address customers' changing needs for state-of-the-art, professional electronic test tools. And the new "economies of scale" allow more efficiencies when learning the unique testing needs of specialized markets, such as automotive, data communications, HVAC, or plant maintenance.

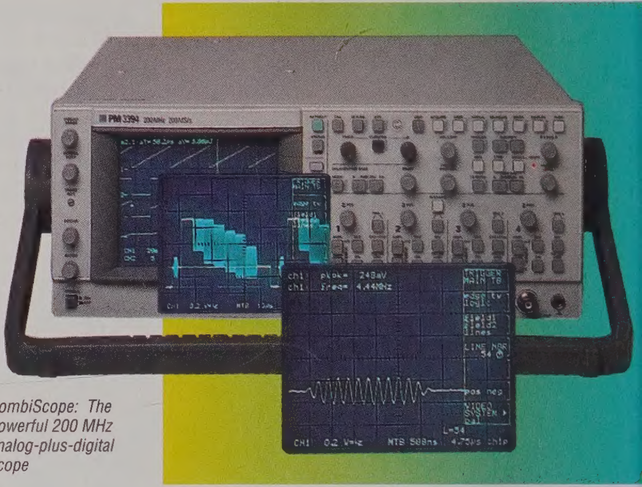
In this catalog you'll see several new tools that Fluke has introduced for these markets. For example, the new 610 Cable Mapper, 650/2 CableMeters, and 670 LANMeter test tools are specifically designed for local area network (LAN) cable installers, LAN maintainers, and LAN managers. In the automotive market, there's the Fluke 78, 86 and 88 Automotive Meters. Also, Fluke offers a new, specialized ScopeMeter tool, the 97 AUTO. All are designed with specialized functions to meet the unique challenges of testing automotive electronics, while reducing much of the complexity often associated with T&M equipment.

Every 97 Auto ScopeMeter test tool gets its start in an ISO-registered manufacturing facility. Fluke's manufacturing plant in Almelo, The Netherlands, was one of the first plants in Europe to become registered for ISO 9001, the internationally recognized standard for quality. Fluke manufacturing facilities in Hamburg, Germany, and Everett, Washington USA, are also ISO 9001-registered. Additionally, all Fluke Service Centers in North America are ISO 9001-registered, as are several Fluke Service Centers in European countries.

Fluke's mission is to be the leader in compact, professional test tools—tools to facilitate high-quality work in less time; tools compact enough to be taken directly to the point where they can do the most good; and tools for professionals who are skilled and experienced and who appreciate the quality and value of superior products.

Developing Powerful New Test Tools

Five years ago Fluke and Philips Electronics Test & Measurement made a pact to share technology, perform joint research, and co-develop new products. Both companies were already leaders in specific T&M product categories: Fluke in digital multimeters and calibration equipment, and Philips in oscilloscopes.



CombiScope: The powerful 200 MHz analog-plus-digital scope

A Scope and a Meter in One

It was only natural that the first combined oscilloscope and multimeter should be a product of Fluke and Philips. In 1991, Fluke and Philips released the **ScopeMeter® test tool**, the result of a two-year R&D effort reflecting Philips' expertise in oscilloscopes and Fluke's expertise in handheld meters. Fluke and Philips product designers proved that two companies could jointly develop a major new product. The ScopeMeter test tool, one of the most successful products in Fluke's 45-year history, is a powerful diagnostic tool for a wide range of commercial and industrial applications. It combines a 50MHz dual-channel digital storage oscilloscope and a $3^2/_3$-digit, true-RMS digital multimeter. And it travels in a toolbelt.

See page 50 for details.

Harmonics are an insidious problem in today's electrical circuits. Caused by nonlinear loads such as fluorescent lights, computers and welders, harmonics can cause overheating and premature failure of distribution transformers.

But the Fluke **80i-1000s AC Current Probe**, in tandem with the ScopeMeter test tool, gives a clear visual indicator of the problem. The 80i-1000s is designed *specifically* for oscilloscopes. Unlike probes that add their own distortion to any distortion already present, the 80i-1000s allows an accurate waveform display that reveals the presence of harmonics.

See page 57,133 for details.

FLUKE 97
Vrms AC+DC
+219.0 HLD
FLUKE

NEW

The 80i-1000s AC current probe is designed specifically for oscilloscopes.

The Fluke ScopeMeter test tool combines a 50 MHz DSO and a true-RMS digital multimeter, plus a generator and counter.

Pioneering New Ideas in Calibration

CombiScope: An Analog/Digital Hybrid

If you're a scope user who wants the best of both worlds, take a look at the **PM 3394 CombiScope™**, a 200 MHz combined analog and digital oscilloscope featuring true four-channel operation. Whether you need a real-time analog picture to view an AM signal, or want to capture, analyze and store single events, the CombiScope test tool has you covered.

The CombiScope's triggering options make it more flexible than many high-powered analog-digital scopes. Besides normal triggering, it offers:

- **State triggering** for microprocessor and logic signals
- **Pattern triggering** for mixed analog/digital circuit analysis
- **Time-qualified pulse triggering** for signals with bursts of multiple frequencies
- **Glitch triggering** for detecting glitches as short as 2 ns.

Memory is another of the CombiScope's strengths; it features an 8K acquisition memory and 16K reference memory.

The PM 3394 is one of four models of powerful 200 MHz analog/digital scopes offered. The family also includes the four-channel PM 3392 and the 2+2-channel PM 3384 and PM 3382. For remote site diagnostics for CombiScope, see TeleGnostics on page VII.

See page 6 for details.

5700A CALIBRATOR
1.000000 V
100 kHz
Output is at calibrator binding posts.
Phase Ctrls Menu
Setup Menus
OPERATE
ENTER

Fluke 5700A: Goes right to the workload to calibrate DMMs on site.

Calibration: The Cornerstone of our Business

It's no wonder the company that built a worldwide reputation for excellence in digital multimeters also pioneered calibration instruments and standards to keep multimeters up to spec.

Fluke's **5700A Calibrator** is a workhorse in the calibration world. This benchtop calibrator covers the bulk of today's workload, a wide range of digital multimeters from all manufacturers.

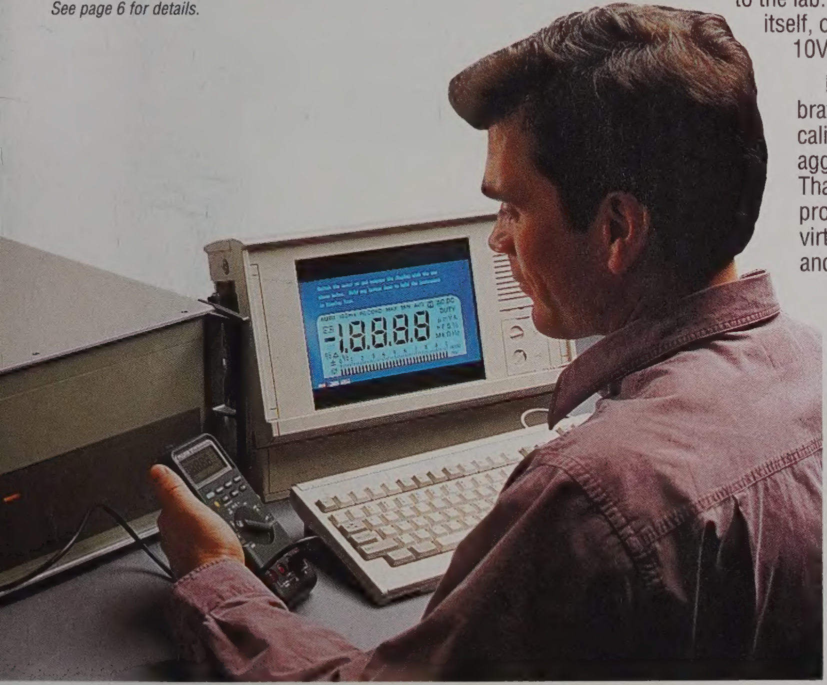
The 5700A goes right to the workload. That means you can calibrate your test instruments on site, eliminating the inconvenience—and downtime—that occur when instruments are sent to the lab. And when it comes time to calibrate the 5700A itself, only three artifact standards are required: 10V dc, 1Ω, and 10 kΩ.

But your company needs more than accurate calibration instruments. It needs accurate and verifiable calibration records--especially in light of today's aggressive new quality standards such as ISO 9000. That's where the **5130A Calibration Workstation** proves its value. You can put the 5130A to work virtually "out of the box" and with existing facilities and personnel. It's an excellent, one-stop solution for calibrating analog or digital multimeters of up to 4½ digits, as well as other electronic measuring instruments.

The 5130A's 5130/CAL software guides the operator through the entire calibration process. And 5130/TRACK software provides a customized database and tracking system for monitoring all of your instrument assets. It's a superb tool for cost-conscious companies that need to meet ISO 9000 calibration standards.

Whether it's hardware or software, standards or procedures, Fluke carries on its tradition of offering a broad range of calibration solutions for your test equipment.

See page 224 for details.



Fluke 5130A: The one-stop calibration workstation

NEW

New Solutions for Data Management

At Fluke, we continually look for ways to make your job easier and more straight forward. Take a look at the compact, portable tools below. You'll find real versatility for data acquisition and management, and new tools for tracking down network problems.

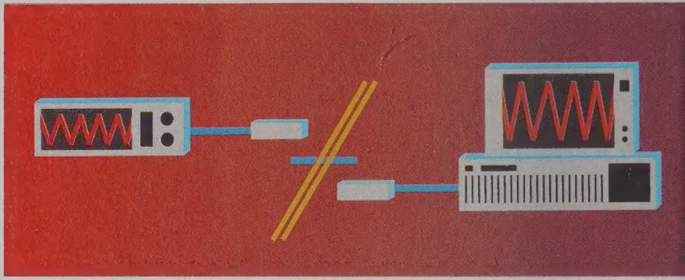
Powerful Data Acquisition

Fluke, a traditional leader in data acquisition instrumentation, surprised the industry in 1992 with the introduction of a line of compact instruments called the Hydra Series. Hydra packaged 21 analog measurement channels and a deep data memory into a portable unit that offered an extensive range of measurement options.

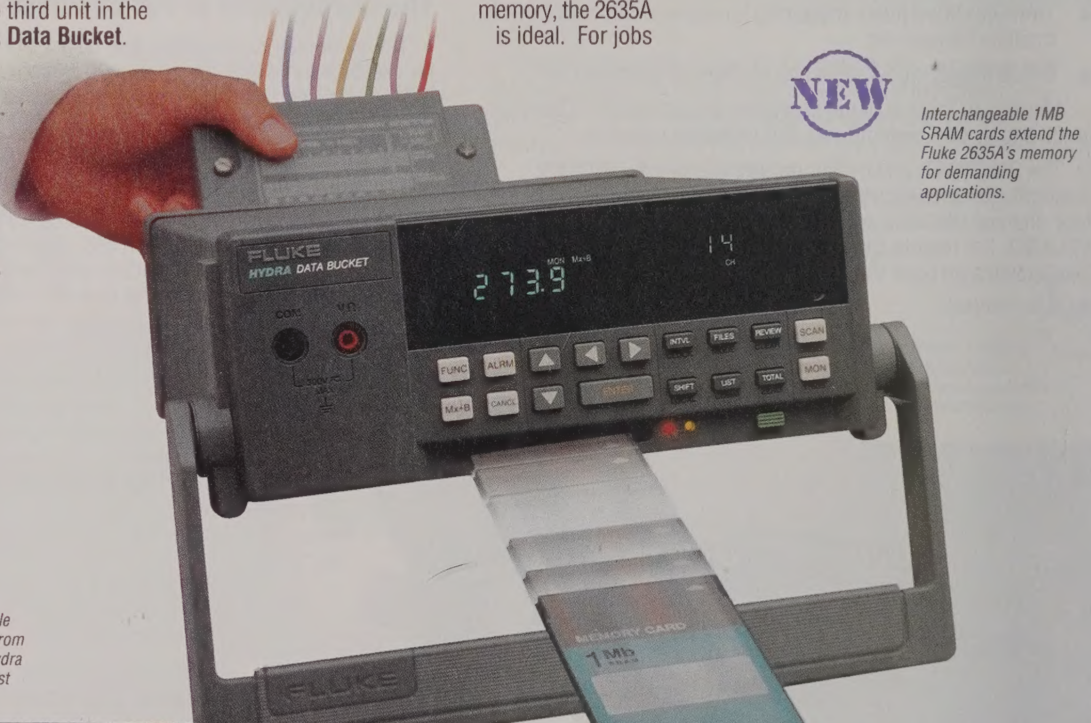
Now comes the third unit in the series: the **2635A Data Bucket**. Taking advantage of the latest developments in memory packaging, the 2635A stores collected data in transportable, shirt-pocket-sized SRAM cards. These interchangeable cards store up to 1MB of data and can be used to transfer measurement data to a PC for post-processing.

For jobs that require a large amount of memory, the 2635A is ideal. For jobs that require power and portability, the 2635A is the ultimate carry-around instrument.

See page 194 for details.



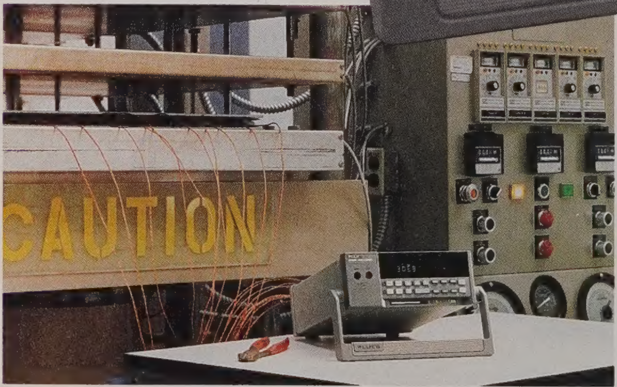
Fluke's TeleGnostics software lets you connect on-site instruments to your PC via modem.



NEW

Interchangeable 1MB SRAM cards extend the Fluke 2635A's memory for demanding applications.

All Hydra units are portable and can operate directly from DC power. That's why Hydra can be found in mobile test applications of all kinds.



and Network Troubleshooting

TeleGnostics: Remote Site Monitoring and Diagnostics

For unmanned, remote monitoring of on-site Fluke T&M equipment, or for a direct link between field engineers and a central service center, Fluke's **TeleGnostics** software package lets you connect on-site instruments to your personal computer via modem. TeleGnostics supports the ScopeMeter, CombiScope and Hydra Series Data Loggers and is the cost-effective solution for performance monitoring and on-the-go service applications.

See page 48 for details.

Solving LAN Problems

If the Eighties was the decade of the personal computer, the Nineties may very well be the decade of the LAN. But operating a LAN can be problematical, especially when a system error occurs. Is the problem in hardware or software? Is it in the server, a client PC, or somewhere in-between?

Fluke is helping LAN problem-solvers answer these questions with a new series of tools that make LAN troubleshooting easier than ever before. **The 670 LANMeter**™ test tool, the first in an entirely new category of LAN tools, combines the most commonly used capabilities of a protocol analyzer with a cable scanner--at a much lower price than protocol analyzers. The 670 is more than just a troubleshooter. It proactively monitors network devices such as servers, bridges and routers. The graphical display of this hand-held unit provides a visual view of your token ring network, quickly diagnosing common problems and isolating faults in physical media, adapter cards, and media access units (MAUs).

The 670 gives you more than data; it gives you a picture of what's right and what's wrong on your network.

See page 219 for details.

For those sticky problems that reside in LAN cabling or connections, Fluke presents the **650 CableMeter**™ test tool. This powerful, portable unit hunts down and isolates cable problems in unshielded twisted-pair or coaxial wiring on network cabling.

The 650 is so easy to learn and use. Just turn the front-panel rotary knob to the desired function and wait a few seconds for the 650 to give you a visual readout of cable errors. Set the unit in Autotest mode, which performs a series of tests, compares results with standards, and provides a pass/fail indication for each test.

See page 217 for details.

FLUKE 670 LANMETER
FLUKE 652 LAN CABLEMETER

NEW

Whether your LAN is just bogging down or it has a fault, the Fluke 670 LANMeter pinpoints the problem quickly.

NEW

Problems in LAN wiring cannot escape the Fluke 650 CableMeter.

Fluke Meters Take You to

If accuracy is what you need in a multimeter, you'll find it here. But a meter has to be more than accurate; it has to be efficient to use. And it may have to be rugged enough to work in extreme conditions.

That's why Fluke offers the widest variety of digital multimeters in the world. Because whether it sits on your bench-top or clips to your belt, your meter has to be ready for anything.

Fluke 45: The Measurement Workstation

To make complicated testing procedures simple, try the Fluke 45 Multimeter with dual 5-digit, 100,000 count displays. Featuring 16 measurement capabilities, 0.02% basic dc voltage accuracy and 0.05% basic dc current accuracy, the Fluke 45 combines an incredible variety of measurement functions and display combinations in one elegant tool. The Fluke 45 also:

FLUKE 45
9.9999
9.9999
FLUKE

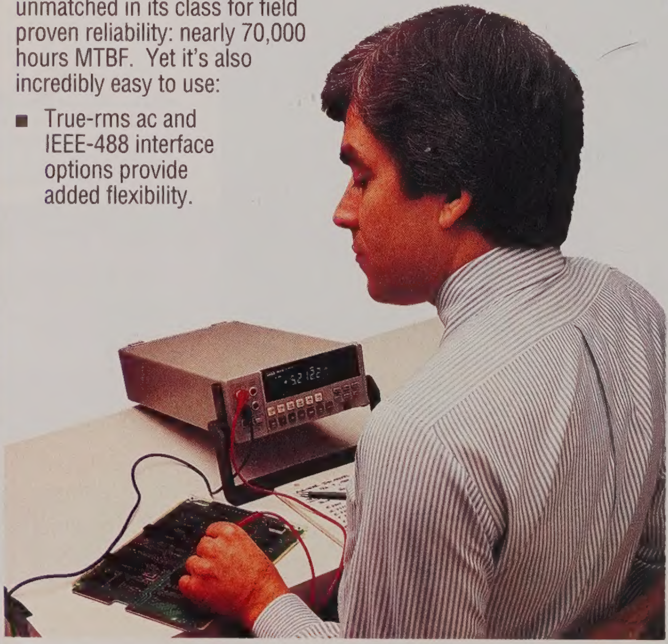
- Measures true-rms voltage and current, including ac + dc.
- Includes 21 different reference impedance measurements.
- Includes Min Max, limits testing (Hi/Lo/Pass), Touch Hold and Relative modes.
- Connects to PCs, RS-232 printers and modems.

See page 66 for details.

Fluke 8840A: Setting Standards for Accuracy and Reliability

If you need accuracy, you need the Fluke 8840A. Even after one year, this 5½-digit DMM has a basic dc accuracy of 0.005%, basic ac accuracy of 0.16%, and basic resistance accuracy of 0.013%. And the Fluke 8840A is unmatched in its class for field proven reliability: nearly 70,000 hours MTBF. Yet it's also incredibly easy to use:

- True-rms ac and IEEE-488 interface options provide added flexibility.



- Throughput can be set for 2.5, 20, or 100 readings/second.
- Resolution of 1 µV, 10 µA, or 1 mΩ.
- Vacuum fluorescent display is bright and easy to read.

See page 70 for details.

Fluke 87: The Truly "Multi" Multimeter

If it has to be mobile and it has to be accurate, reach for a Fluke 80 Series handheld multimeter.

Consider the Fluke 87, for example. This high-resolution digital multimeter sports more features than any other handheld DMM. The 4000-count digital readout has a 20,000-count mode for 4½-digit resolution. The Fluke 87 also records minimums and maximums, plus true arithmetic average. It features audible Min Max alert and selectable response times—1 second and 100 ms plus 1 ms Peak Min Max. And it measures duty cycle. It also features:

- An analog display that updates 40 times/second.
- A frequency counter capable of reading frequencies as low as 0.5 Hz.
- Capacitance testing.
- Autoranging, with manual ranging at the touch of a button.
- An advanced protection holster with Flex Stand.

See page 116 for details.

FLUKE 87 TRUE RMS MULTIMETER
MIN MAX
RANGE
HOLD
REL Δ
Hz
PEAK MIN MAX
OFF
mV
V
mA A
µA
A
mA µA
COM
V Ω
10A MAX FUSED
400mA MAX FUSED
1000V MAX

New Levels of Efficiency

Multimeter Accessories Let You Measure Almost Anything

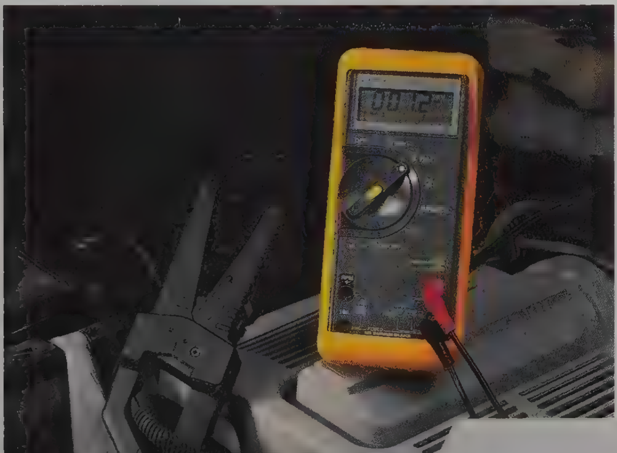
For added versatility try one of Fluke's new plug-in accessories. They're perfect for measuring temperature, pressure and vacuum. Fluke offers a broad variety of other multimeter accessories, too. See the Multimeters Accessories section in this catalog.

Fluke 80T-IR. Use your Fluke digital multimeter to make non-contact temperature measurements. The 80T-IR converts infrared energy into a temperature reading—ideal when the subject is electrically live, moving, or hard to reach, or can be contaminated by touch. This handheld accessory displays temperature in Fahrenheit or Celsius. Its remarkably low price makes it a comfortable fit for your budget, too.

See page 151 for details.

Fluke PV350 & PV500. These digital modules are a real improvement over traditional analog gauges. The PV350 is designed for HVAC/R and plant maintenance applications, and measures hydraulic and pneumatic pressures up to 500 psig (3447 kPa). The PV500 is designed for automotive applications and measures pressures up to 600 psig (4137 kPa). Both units also measure vacuum up to 29.99" (76 cm) Hg.

See page 141 for details.



Fluke 78 Automotive Meter: The Compact Solution for Your Automotive Electrical Needs

If you work on automotive electrical systems, you need the Fluke 78. This meter does it all: it checks volts, amps, continuity and resistance. Its precision analog bar graph gives accurate trend information for variable readings, updating 40 times/second. Use the Fluke 78 to test frequency, duty cycle, temperature up to 980°F (527°C), and direct reading dwell. The Fluke 78 provides a 4000-count digital readout.

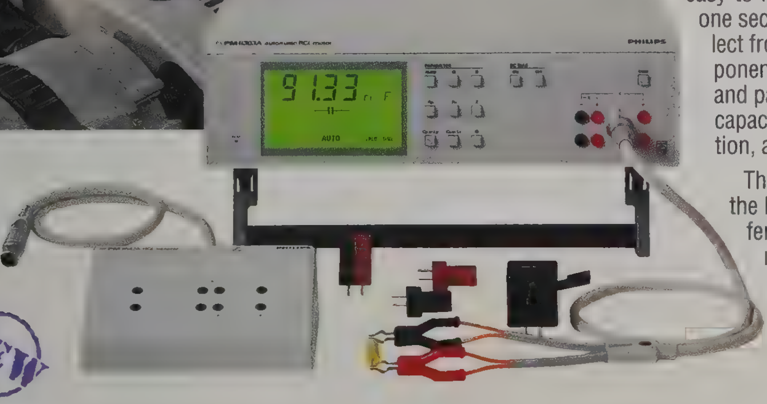
See page 111 for details.

PM 6303A/6304A RCL Meters: Programmable Component Testing the Easy Way

For easier programmable component testing, try one of these RCL meters from Fluke. Just connect your component to the test fixture, and the dominant component value appears with an equivalent circuit diagram on the large, easy-to-read LCD display--in less than one second. Use AUTO mode, or select from one of nine different component parameters, including series and parallel resistance, impedance, capacitance, inductance, dissipation, and quality factors.

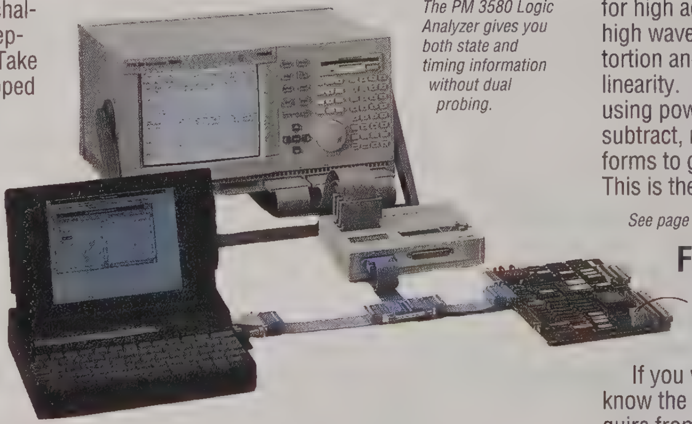
The PM 6304A contains most of the PM 6303A's features, but offers higher accuracy, additional measurement power, and remote programmability.

See page 98, 100 for details.



New Power in

Today's toughest testing challenges require tools with exceptional power and versatility. Take a look at how Fluke has equipped traditional workhorse tools to meet these challenges.



The PM 3580 Logic Analyzer gives you both state and timing information without dual probing.

Troubleshoot Hardware and Software Simultaneously

The **PM 3580 Logic Analyzer** has been widely acknowledged for its ability to provide state and timing data from the same signal without dual probing. The result is a tool that is equally adept at troubleshooting hardware and software. And what about performance measures? The PM 3580 offers timing analysis up to 200 MHz and state analysis up to 50 MHz.

The PM 3580 is better suited than ever for a wide variety of users and applications. New system software and a new mouse option have made the PM 3580's award-winning user interface even easier to work with. Along with greater ease of use comes a broader range of troubleshooting options: support for the latest microprocessors and for an extensive range of buses.

If you need real-time information about how your hardware and software work together, you need the performance standard in logic analyzers: the PM 3580.

See page 273 for details.

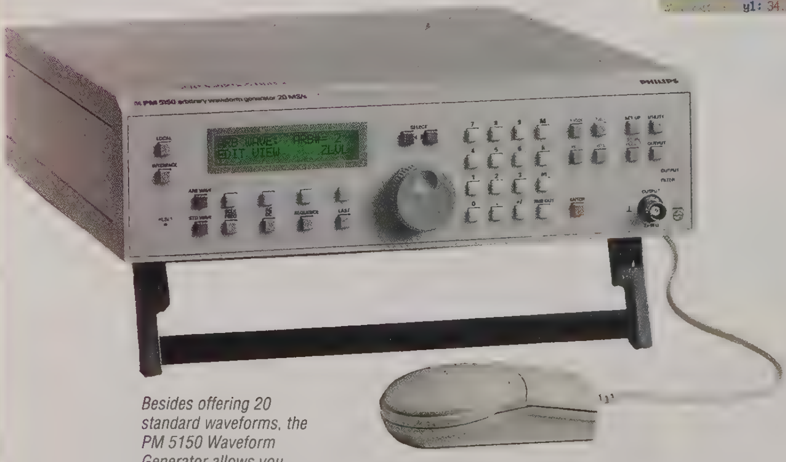
Real-World Waveforms at Your Fingertips

Fluke's **PM 5150 Arbitrary Waveform Generator** is an exceptionally versatile instrument incorporating 20 standard waveforms plus the ability to generate any desired custom waveforms for specialized testing and simulation.

With 32K of nonvolatile waveform memory, the PM 5150 stores waveforms and can recall them instantly. The most complex tests and simulations you need—or can imagine—are just a few pushbuttons away.

All waveforms are digitally synthesized, with 12-bit amplitude resolution (4096 points) for high accuracy. This technique ensures high waveform quality with low sine distortion and excellent triangle and ramp linearity. Edit your waveforms as required using powerful internal functions. Add, subtract, multiply, or sequence waveforms to generate special test signals. This is the ultimate waveform generator.

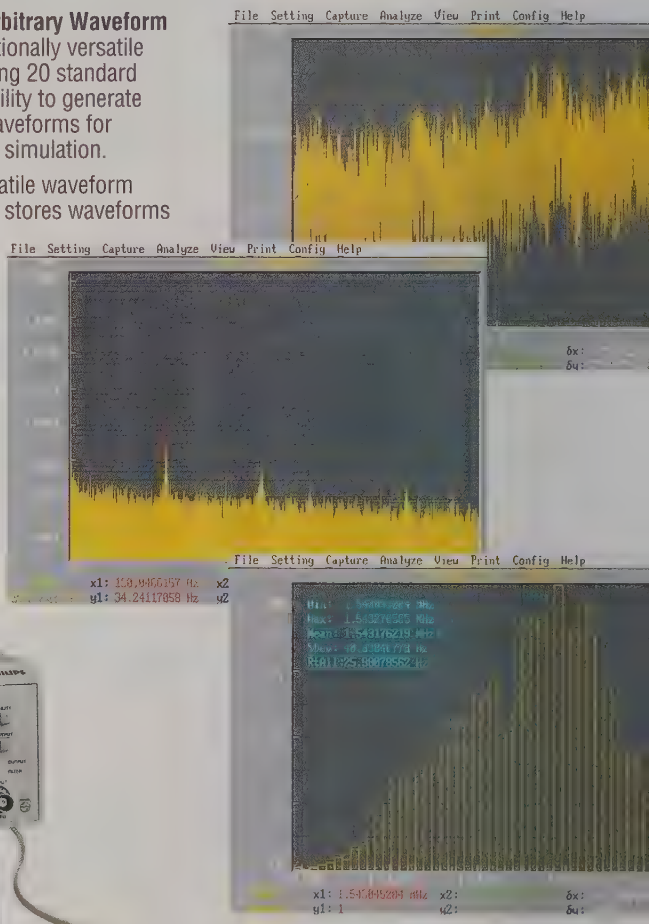
See page 321 for details.



Besides offering 20 standard waveforms, the PM 5150 Waveform Generator allows you to generate and store custom waveforms.

Frequency Counter Mixes Power with Simplicity

If you work in a calibration lab, you know the level of resolution that you require from your lab instruments. Imagine finding an affordable tool that gives you the same resolution in the field. Imagine the **PM 6685 Frequency Counter**.


File Setting Capture Analyze View Print Config Help
File Setting Capture Analyze View Print Config Help
File Setting Capture Analyze View Print Config Help

y1: 34.24117058 Hz

Max: 1.543276565 MHz

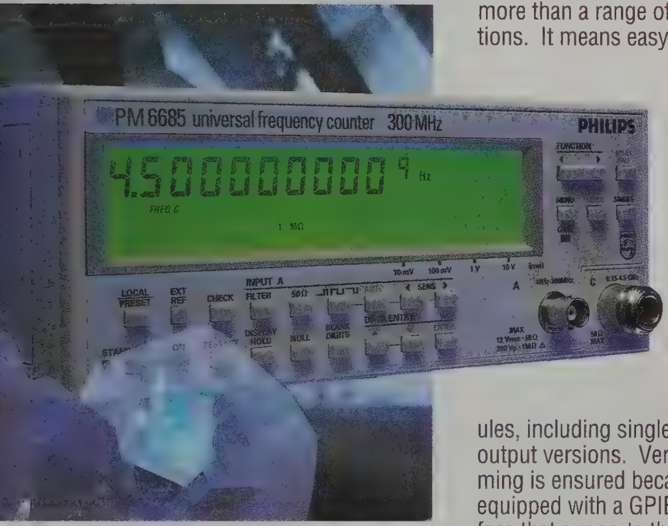
Mean: 1.543176219 MHz

y1: 1

Fluke's TimeView sofware lets you couple the PM6680 Frequency Counter with a PC and perform extensive time and frequency analysis in the modulation domain. See page 166 for details.

Traditional Test Tools

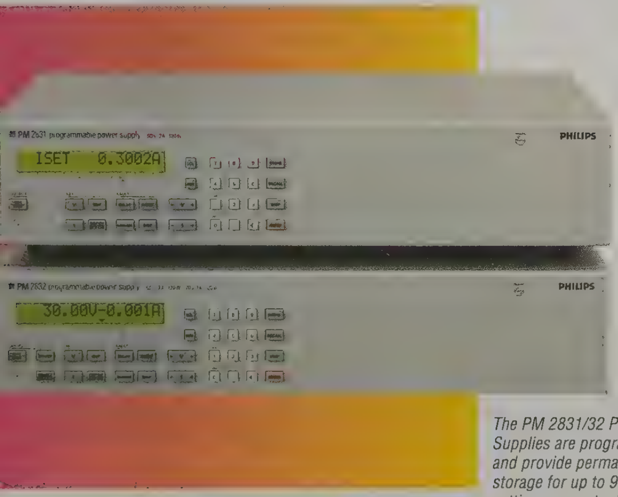
The PM 6685 brings you 10-digits-per-second resolution over a 300 MHz bandwidth as standard. Plus, it performs nine-digit measurements four times a second, allowing you to make calibration adjustments in real time.



The PM 6685 Frequency Counter offers calibration-lab accuracy in the field.

Plus, this high-resolution instrument is uncharacteristically easy to operate. It automatically sets the proper trigger level and adjusts the input sensitivity, eliminating manual steps and ensuring both excellent noise immunity and error-free triggering. Because its digital readout is supplemented by an analog bar graph, you get instant visual feedback on whether the signal level is adequate.

See page 178 for details.


PM 2831 programmable power supply
PHILIPS
ISET 0.3002A
PM 2832 programmable power supply
PHILIPS
30.00V-0.001A

The PM 2831/32 Power Supplies are programmable and provide permanent storage for up to 99 settings per output.

New Power in Power Supplies

True power in a power supply means more than a range of power output options. It means easy programmability. It means protection against power fluctuations or errors that could damage your equipment. If these are your expectations, meet the **PM 2831** and **PM 2832**.

These power supplies work with a variety of autoranging and linear output power modules, including single-, dual-, and triple-output versions. Versatility in programming is ensured because each model is equipped with a GPIB/IEEE-488.2 interface that supports the SCPI (Standard Commands for Programmable Instrumentation) standard. SCPI provides a common command set across a wide range of T&M instruments.

Protection against voltage drops, overvoltages, and overcurrents is built in. Even the power supply's internal temperature is continuously monitored. These units also offer powerful memories. Up to 99 settings per output can be stored and recalled—each from nonvolatile memory with battery backup.

The PM 2832 and PM 2831 really put you in power.

See page 315 for details.

The Tester for Your 8-, 16-, and 32-Bit Boards

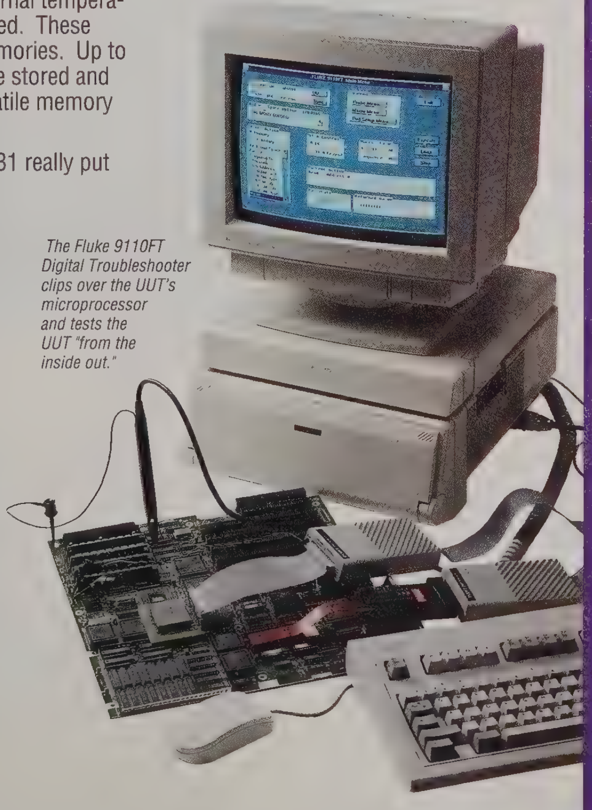
How can you justify acquiring one digital troubleshooter for earlier 8-bit microprocessor-based boards and another for today's 16- and 32-bit boards? You don't have to. All you need is a Fluke **9110FT Digital Troubleshooter**.

The 9110FT was designed to isolate board faults on the new generation of complex boards—with lots of reserve power for earlier boards. Used with Fluke's SPECTRUM-TX software interface, this immediate-mode troubleshooter pinpoints faults in the microprocessor kernel up to 30% faster than with traditional tools.

The 9110FT employs emulative testing, a process pioneered by Fluke to eliminate the "hit or miss" method of capturing dynamic signals on a microprocessor bus. Using emulative testing, the 9110FT controls the board in the same way it operates—from the microprocessor circuitry outward. The result is more powerful and more comprehensive testing.

See page 284 for details.

NEW



The Fluke 9110FT Digital Troubleshooter clips over the UUT's microprocessor and tests the UUT "from the inside out."

T&M Solutions Around the Globe

Fluke Park, Everett, Washington
Headquarters for Fluke's Service Tools and Verification Tools Divisions

Almelo facility, The Netherlands
Headquarters for Fluke's Diagnostic Tools Division

If you're looking for power, versatility and ease of use in your T&M equipment, look to Fluke. We're there for you—worldwide.

Whether we're adding a new twist to traditional test tools, or expanding the horizons of T&M with new tools and applications, we know you expect rugged designs, innovative features, and high reliability. Because we know the real measure of your tools is how well they get the job done.

And when it comes to service and support, we're there for you too—worldwide. Because your time is at a premium, you need tools that work just as hard, and just as reliably, as you do.

The bottom line is value. Cutting-edge technology and unique features designed for the real world make Fluke tools your T&M solutions. Unparalleled reliability means you can trust your data in any environment. And top-flight support means getting the greatest possible value for your investment.

Fluke products are sold and serviced in over 85 countries around the globe. For the name and location of your closest source, please refer to the Ordering Information section of this catalog.

U.S. Prices April 1, 1994

Prices subject to change without notice. These prices apply to products purchased and used in U.S. only.

Fluke Products Available Through Authorized Distributors

ITEM	PRICE	EXT WRTY[1]
A81 (any)	32	
AC20	22	
AC70A	7	
AC75	7	
AC80	17	
AC83	20	
AC85A	9	
AC89	22	
C10	10	
C12	12	
C20	27	
C25	21	
C30	15	
C31	16	
C40	50	
C50	16	
C610	35	
C70G	16	
C70Y	16	
C75	6	
C81G	16	
C81Y	16	
C86	20	
C90	16	
C95	102	
C97	55	
C100	30	
C800	28	
HM 9606/01	165	
HM 9606/02	185	
M00-200-611	75	
M00-200-612	81	
M00-200-613	89	
M00-200-634	122	
N6100	45	
N6101	125	
N6102	165	
N6103	30	
N6201	90	
N6202	120	
N6203	140	
PM 2193/03	300	
PM 2525/033	1025	
PM 2525/233	1225	
PM 2525/533	1345	
PM 2525/633	1230	
PM 2525/733	1540	
PM 2618/323	1025	
PM 6303A	1560	
PM 6662/011	780	
Gp 1 Options***		
/0--	NC	
/4--	410	
Gp 2 Options***		
/-1-	NC	
/-3-	320	
Gp 3 Options***		
/--1	NC	
/--3	350	
/--6	310	
PM 6665/011	1065	
Options:		
See PM 6662/011		
PM 6666/011	1170	
Options:		
See PM 6662/011		
PM 6669/011	950	
Options:		
See PM 6662/011		
PM 8907/003	62	
PM 8907/008	72	
PM 8918/002	176	
PM 8918/202	202	
PM 8943A/003	1025	
PM 9001/001	70	
PM 9001/201	85	
PM 9003/001	65	
PM 9011/001	80	
PM 9074	25	
PM 9080/001	145	
PM 9081/001	26	
PM 9082/001	26	
PM 9083/001	41	
PM 9084/001	36	
PM 9085/001	36	
PM 9086/001	41	
PM 9087/002	93	
PM 9090/001	36	
PM 9091/001	62	
PM 9092/001	52	
PM 9093/001	36	
PM 9094/001	62	
PM 9095/001	35	
PM 9100/001	145	
PM 9218A/013	65	
PM 9244	95	
PM 9249/01	205	
PM 9264/01	120	
PM 9266/03	60	
PM 9355/09Q	1290	
PM 9541A	110	
PM 9542A	330	
PM 9542SMD	130	
PM 9581/01	100	
PM 9585/01	50	
PM 9604/00	310	
PM 9605/00	350	
PM 9607/00	320	
PM 9608B/00	410	
PM 9609	100	
PV350	229	69
RS40	30	
RS41	30	
S45	95	
TL20	42	
TL22	15	
TL24	15	
TL26	35	
TL28	23	
TL70A	10	
TL75	9	
TP20	8	
TP80	17	
~~Y8021~~	~~175~~	
Y8022	190	
Y8023	200	
Y8077	50	
Y8100	319	67
Y8101	79	44
Y8131	15	
Y8132	15	
Y8133	36	
Y8134	36	
Y8140A	24	
Y8205	43	
Y8834	85	
Y8835	145	
Y8836	85	
Y9104	20	
10	69.95	
11	79.95	
12	95	
21-2	149	30
23-2	179	30
25 (both)	235	45
27 (both)	299	45
29-2	199	40
30	99	35
31	199	40
33	269	45
37	285	45
40	1200	98
41	1700	117
45	659	65
45-01	789	65
45-05	819	65
45-15	949	65
*45-01K	170	
*45-05K	200	
51	149	35
52	199	40
610[2]	395	25
620[2]	795	75
650[2]	1795	50
650R[2]	185	26
652[2]	2395	70
70-2	79	30
73-2	109	30
75-2	149	30
77-2	179	30
79-2	199	35
80CJ-M	11	
80CK-M	11	
80i-kW	549	
80i-400	83	37
80i-410	179	44
80i-5005	170	40
80i-600	119	40
80I-1000s	395	37
80i-1010	297	73
80J-10	56	49
80K-6	57	49
80K-40	106	42
80PK-1	12	
80PK-2A	46	
80PK-3A	85	
80PK-4A	64	
80PK-5A	58	
80PK-6A	57	
80T-H	140	
80T-IR	219	60
80TK	69	36
80T-150U	120	50
83	265	35
83RF	79	
85	305	35
85RF	99	
87	335	35
93	1395	120
95	1695	124
97	1995	129
8010A	399	53
8010A-01	444	57
8012A	409	53
8012A-01	454	57
8050A	499	95
8050A-01	544	98
8060A	459	53
8062A	389	53
8840A	920	170
8840A/05	1100	170
8840A/059	1330	170
8840A/09	1150	170
*884XA-05K	205	
*8840A-09K	250	
8842A	1150	182
8842A/05	1325	182
8842A/059	1570	182
8842A/09	1415	182
*884XA-05K	205	
*8842A-09K	310	

ITEM	PRICE	EXT WRTY[1]
A40 (any)	895	165
A40A (any)	1000	165
A45-4003	120	
A45-4004	155	
A55 (any)	1065	200
A55-110	1065	
A90	900	355
CAL/PACK-51	15,450	
CAL/PACK-51K	16,450	
CAL/PACK-57	28,450	
CAL/PACK-57K	29,450	
CAL/TRACK	9950	
CAL/TRACK-K	10,950	
C41	835	
C41S	69	
C42	60	
C55	835	
C650	100	
C652	110	
C6700	150	
MEE-7001	165	
MET/CAL	5950	
MET/CAL-K	6950	
MET/CAL-U3	600	
MET/CAL Course:		
TRC1006	1495	
MET/TRACK	6450	
MET/TRACK-ND	250	
MET/TRACK-U3	600	
MET/TRACK Course:		
TRC1007	1495	
MIS-7011K	325	
MIS-7013K	150	
MIS-7190K	650	
MIS-7191K	755	
M00-260-610	175	
M00-270-610	175	
M00-280-610	175	
M03-206-604	225	
M04-205-600	120	
M04-205-601	285	
M05-200-603	150	
M05-203-601	165	
M05-203-602	165	
M05-205-600	125	
M07-200-603	130	
M07-205-600	155	
M08-205-600	155	
M10-205-600	155	
Microfiche Service		
for PCNs	295	
N6520	125	
N6521	95	
N6701	139	
N6703	245	
N6704	140	
N6705	245	
N6708	195	
N6709	195	
RS42	35	
S45	95	
S1703	2600	
S1705	2600	
S2290	995	
TC100	510	
TC100-01	40	
TC100-02	75	
TC100-03	75	
TC100-04	155	
V7800	2450	
V7800-001	295	
V7800-002	1150	
V7800-002W	1150	
V7800-004	395	
V7800-004W	395	
V7800-005	495	
V7800-006	795	
V7800-010	125	
V7800-011	125	
V7800-020	250	
V7800-021	495	
V7800-022	995	
V7800-040	1195	
V7800-040W	1195	
V7800-041	995	
V7800-045	495	
V7800-046	795	
V7800-049	295	
V7800-100	595	
V7800-101	195	
V7800-102	295	
V7800-103	295	
Y1700	585	
Y1702	180	
Y1704	285	
Y1706	95	
Y1707	180	
Y1717	210	
Y1720	495	
Y1750	95	
Y1752	75	
Y1753	270	
Y1790	275	
Y1795	70	
Y2014	115	
Y2015	135	
Y2042	170	
Y2044	235	
Y2045	180	
Y2046	70	
Y2047	90	
Y2048	115	
Y2049	305	
Y2053	250	
Y2054	200	
Y2056	375	
Y2451	1230	
Y2452	2300	
Y5000	855	
Y5001	380	
Y5002	335	
Y5003	165	
Y5020	955	153
Y5021	775	
Y5701	330	
Y5702	330	
Y5735	355	
Y5737	355	
Y7203	65	
Y7204	80	
Y734	335	
Y8007	150	
Y8021	175	
Y8022	190	
Y8023	200	
Y8077	50	
Y8091	85	
Y8092	85	
Y8404	445	
Y8597	260	
Y8598	190	
Y8599	95	
Y8836	85	
Y900-002	400	
Y900-003	30	
Y900-004	30	
Y900-005	65	
Y900-006	410	
Y900-007	205	
Y900-008	40	
Y900-14D	180	
Y900-14S	180	
Y900-16D	180	
Y900-16DZ	300	
Y900-16S	180	
Y900-18D	180	
Y900-20D	180	
Y900-20P	350	
Y900-20S	230	
Y900-24D	180	
Y900-24DW	180	
Y900-24S	230	
Y900-28D	180	
Y900-28DN	180	
Y900-28P	350	
Y900-28S	230	
Y900-8D	180	
Y900-8S	180	
Y9000A-80286		
-7202	395	
Y9100A-DCS	1325	
Y9100A-14D	215	
Y9100A-14S	215	
Y9100A-16D	215	
Y9100A-16S	215	
Y9100A-18D	215	
Y9100A-20D	215	
Y9100A-20L	215	
Y9100A-20S	215	
Y9100A-24D	215	
Y9100A-24S	215	
Y9100A-28D	300	
Y9100A-28S	300	
Y9100A-40D	300	
Y9100A-100	255	
Y9100A-101	305	
Y9100A-102	205	
Y9100A-7201	50	
Y9100A-7203	50	
Y9132A-64180		
-7201	510	
Y9132A-64180		
-7202	510	
Y9308	30	
Y9401	80	
Y9403	79	
93	1395	120
95	1695	124
97	1995	129
343A	9950	866
670[3]	6495	245
670/BL	6795	245
672	6495	245
672/BL	6795	245
675	9495	325
675/BL	9795	325
720A	10,215	
731B		438
*732A-000R	595	
*732A-200	895	
*732A-201	125	
732B	3950	485
*732B-000	395	
*732B-000I	795	
*732B-100	895	
*732B-100I	1295	
*732B-7001	1235	
*732B-7002	695	
734A	14,650	1390
*734A-7001	1290	
742A-1	1500	390
742A-1K	1500	390
742A-1M	1500	390
742A-1.9	1500	390
742A-10	1500	390
742A-10K	1500	390
742A-10M	1500	390

Continued...

See page 4 for footnote descriptions.

FLUKE®

U.S. Prices April 1, 1994

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ITEM	PRICE	EXT WRTY[1]
742A-19K	1500	390
742A-19M	1500	390
742A-100	1500	390
742A-100K	1500	390
*742A-7002	300	
752A	7500	275
792A	24,950	4325
792A-7001	3145	
792A-7002	2285	
792A-7003	1500	
792A-7004	835	
845AB	4950	198
845AR	4450	198
900/BP	6995	433
900-001K	2300	
900-003K	525	
900-901	300	
900-903	650	
900-8211	120	
900-8239	280	
1120A	1025	124
1702A	3380	320
1711A/AA	6350	
*1711A/AA-200U	210	
*1711A-440	3260	
1722A	9870	
1722A-1	9600	
1722A/AP	15,500	
*17XXA-002	1390	
*17XXA-004	4450	
*17XXA-005	7450	
*17XXA-008	1200	
*17XXA-009	1390	
*17XXA-016	1360	
*17XXA-017	4395	
*17XXA-018	2340	
*17XXA-019	3685	
*17XXA-020	5050	
*1722A-200U	210	
*17XXA-201	2100	
*17XXA-201U	210	
*17XXA-202	2100	
*17XXA-202U	210	
*17XXA-203	655	
*17XXA-203U	210	
*17XXA-205	655	
*17XXA-205U	210	
*1722A-440	2720	
*17XXA-900	45	
*17XXA-901	270	
*17XXA-902	410	
*17XXA-903	410	
*17XXA-905	410	
*17XXA-907	620	
*17XXA-912	2720	
*17XXA-913	2050	
1752A	11,200	
1752A-1	10,000	
*1752A-010	1390	
*1752A-011	1390	
*1752A-012	960	
*1752A-013	715	
*1752A-200U	210	
*1752A-440	2720	
2205A	3940	466
*2205A-009K	190	
*2205A-050	335	
*2205A-100	590	
*2205A-110K	500	
*2205A-200	590	
*2205A-210K	500	
*2205A-300	590	
*2205A-400	1405	
*2205A-600	825	
*2205A-610K	670	
2280-MAN-SET	125	
2280X-UGK:		
*2280X/2286A-UGK	2600	
2281A	1050	382
*2281A-402	10/m	
*2281A-403	110	
*2281A-431	660	
2282A	2750	
2285B	6760	719
2286A	9495	685
2287A	3990	438
2289A	2800	564
*2285B/2286A-UGK	3600	
*228XX-160	345	
*228XX-161	930	
*228XX-162	775	
*228XX-163	1100	
*228XX-164	805	
*2287A-165	1475	
*228XX-167	1095	
*228XX-168	835	
*228XX-169	160	
*228XX-170	1245	
*228XX-171	245	
*228XX-174	460	
*228XX-175	205	
*228XX-176	140	
*228XX-177	300	
*228XX-179	160	
*2286A-211	1450	
*228XX-214	2650	
*2287A-265	500	
*228XX-341	1070	
*228XX-342	1070	
*2289A-901	390	
*2289A-902	4275	
*2289A-903	735	
*2289A-903U	100	
22810A	4695	564
22811A	5695	
2620A	2395	155
2620A/05	2650	155
*2620A-05K	260	
*2620A-100	195	
*262XA-801	399	
*262XA-901	390	
*262XA-901D	390	
*262XA-901DU	80	
*262XA-901U	80	
2625A	3100	155
2625A/WL	3995	170
*2625A/WL-700	1995	149
*2625A/WL-701	1150	149
*26X5A/WL-702	975	149
*26X5A/WL-703	150	
*26X5A/WL-902	995	
2635A	3495	165
*263XA-803	390	
*263XA-804	175	
*263XA-805	395	
5100B	13,450	1297
5100B-9000	15,950	
5100B-9000K	16,950	
5101B	16,225	1461
5102B	17,800	1252
*5100A-03	3650	
*5100A-05	770	
*5100A-06	770	
*5100A-7003K	1295	
*5100A-7005K	660	
5130A	9950	1252
*5130A-CT	2500	
5130A/HW	8950	
5130A/SW†††	4995	
5200A	15,950	1103
5200A/5205AK	14,490	
5200A/5215A	31,135	
*5200A-01	1760	
*5200A-03	595	
*5200A-05	2890	
*5200A-05K	2890	
*5200A-800	715	
*5200A-900	1355	
*5200A-902	1355	
*5200A-7015K	410	
5205A	14,650	1383
5205A-01	10,250	
5205A-07	14,650	
5215A	15,620	1291
5215A-07	15,620	
5220A	7615	507
5440B	18,950	1300
*5440A-7001	330	
*5440A-7002	475	
*5440A-7003	375	
5450A	7450	1781
5700A	26,450	842
5700A-9000	28,950	
5700A-9000K	29,950	
*5700A-01	0	
*5700A-03††	5950	
*5700A-200	895	
*5700A-7001K	835	
*5700A-7002	9800	
5725A	9950	384
*5725A-01	0	
*5725A-7001K	415	
5790A	16,950	2990
*5790A-03	4255	603
*5790A-7001	540	
Metrology Course:		
TRC1000	1495	
6160B	9995	546
*6160B-02	1615	
*6160B-04	80	
*6XXXA-529	515	
7409B-CG5011	22,950	604
*74XXX-014	549	
Cal Lab Mgt Course:		
TRC1005	1495	
8025A	295	45
8025B	380	45
8505A	5950	595
*8505A-02B	860	
8506A	10,950	1265
8505A/8506A Options:		
*8500A-01	1080	
*8500A-01K	1130	
*8500A-03	870	
*8500A-03K	900	
*8500A-05	855	
*8500A-05K	885	
*8500A-06	855	
*8500A-06K	885	
*8500A-08	345	
*8500A-08K	370	
*8500A-09A	1305	
*8500A-09AK	1185	
*8500A-09K	710	
*8500A-17K	290	
8520A	5520	524
*8520A-010	920	
8520A/AS-1	7995	
8520A/PRT	12,610	
8522A	8540	554
8840A	920	170
8840A/05	1100	170
8840A/059	1330	170
8840A/09	1150	170
*884XA-05K	205	
*8840A-09K	250	
8840A/AF	1710	176
8840A/AF/05	1885	176
8842A	1150	182
8842A/05	1325	182
8842A/059	1570	182
8842A/09	1415	182
*884XA-05K	205	
*8842A-09K	310	
8920A	2950	660
8921A	2950	660
8922A	3100	676
*892XA-003	400	
*892XA-004	340	
*892XA-521	335	
*892XA-521K	360	
*8XXXA-522K	300	
*892XA-529	565	
*9000A-006	1150	
*9000A-Z80QT	2100	185
*9000A-Z8000	2700	185
*9000A-200	205	
*9000A-201	105	
*9000A-900	310	
*9000A-910	100	
*9000A-1802	2100	225
*9000A-6502	1900	185
*9000A-6800	1900	185
*9000A-6802	1900	185
*9000A-6809	2100	185
*9000A-8048	2700	185
*9000A-8051	2700	185
*9000A-8080	1900	185
*9000A-8085	1900	185
*9000A-8086	3200	185
*9000A-8088	3200	185
*9000A-9900	2600	185
*9000A-68000	3200	185
*9000A-80186	4200	260
*9000A-80188	4200	260
*9000A-80286H	4200	322
9005A	4405	273
9010A	6605	308
†Troubleshooting Course:		
TRB9000	659	
TRB9110	1095	
Programming Course:		
TRB9001	659	
*9010A-001	475	
*9010A-920	510	
*9010A-923	520	
9020A-001	6920	299
9020A-002	6920	299
9100FT	19,995	456
9100FT/EXE32	27,500	
9100FT/SYS	35,000	760
*9100FT-031	3000	
9105FT	17,000	371
*910XA/SS	1000	
*9100A/SYS/SS	2500	
*9100A-003	3315	176
*9100FT-004	8950	
*9100A-009	815	132
*9100A-017	4995	199
*9100A-020	300	
*9100A-030	460	
*9100A-903	1250	
*9100A-904	3100	
*9100A-905	20,000	
†Applications Courses:		
TRB9102	1325	
TRB9103	1649	
9110FT	13,500	488
9110FT/PKG32	17,500	665
9110FT-006	585	
9110FT-906	1995	
9132FT	5800	240
*9132FT-DIP32	450	
*9132FT-DIP40	450	
*9132FT-ROM	1200	
*9132FT-R3000	2600	
*9132FT-v2.1k	795	
*9132FT-68020	2600	
*9132FT-68030	2600	
*9132FT-68040	2600	
*9132FT-68302	2600	
*9132FT-80286	2600	
*9132FT-80386	2600	
*9132FT-80486	2600	
*9132FT-80386SX	2600	
*9132FT-80960MC	2600	
*9132A-R2000	2600	
*9132A-320C2X	2600	
*9132A-64180	2600	
*9132A-68HC11	2600	
*9132A-68000	2600	
*9132A-7810	2600	
*9132A-80C186	2600	
*9132A-80C88	2600	
*9132A-80386SX	2600	
9420/SYS	32,650	
9420/SYS/NR	30,075	
*9400-101	3405	
*9400-102	360	
*9400-201	515	
*9400-202	525	
*9400-401	2575	
*9400-701	200	
*9420-001	515	
*9420-064	775	
*9420-601	3500	
*9421	5045	
94X0-600	395	
PM 2101/023	875	57
PM 2120/02	630	29
PM 2121/02	790	32
PM 2122/02	900	32
PM 2124/02	890	32
PM 2130/02	760	29
PM 2131/02	760	29
PM 2132/02	760	29
PM 2140/02	790	53
PM 2141/02	905	53
PM 2150/02	525	22
PM 2160/02	790	22
PM 2190/02	250	
PM 2191/01	255	
PM 2191/10	95	
PM 2192/01	85	
PM 2193/03	300	
PM 2194/02	100	
PM 2198/023	465	
PM 2201/03	760	
PM 2201/98	650	
PM 2202/02	880	
PM 2202/98	765	
PM 2252/001	225	
PM 2255/001	335	
PM 2270/003	200	
PM 2270/903	120	
PM 2271/002	305	
PM 2272/001	255	
PM 2273/001	410	
PM 2273/901	285	
PM 2296/50	85	
PM 2296/60	110	
PM 2392/01	170	
PM 2505/04	420	
PM 2518/023	365	
PM 2518/123	480	
PM 2525/033	1025	168
PM 2525/233	1225	168
PM 2525/533	1345	168
PM 2525/633	1230	168
PM 2525/733	1540	168
PM 2534/023	1420	152
PM 2535/023	1675	152
PM 2618/023	420	
PM 2618/123	545	
PM 2618/323	1025	
PM 2718/023	520	
PM 2718/123	605	
PM 2811/013	1825	132
PM 2811/053	1930	132
PM 2811/113	1825	132
PM 2811/153	1930	132
PM 2812/013	3220	151
PM 2812/053	3350	151
PM 2812/113	3220	151
PM 2812/153	3350	151
PM 2812/213	3220	151
PM 2812/253	3350	151
PM 2812/313	3635	151
PM 2812/353	3805	151
PM 2812/413	3635	151
PM 2812/453	3805	151
PM 2813/013	3810	164
PM 2813/053	4050	164
PM 2813/113	3810	164
PM 2813/153	4050	164
PM 2813/213	3810	164
PM 2813/253	4050	164
PM 2813/313	3810	164
PM 2813/353	4050	164
PM 2831/013	2180	132
PM 2831/053	2270	132
PM 2831/113	2180	132
PM 2831/153	2270	132
PM 2831/213	2180	132
PM 2831/253	2270	132
PM 2832/013	3740	151
PM 2832/053	3915	151
PM 2832/113	3740	151
PM 2832/153	3915	151
PM 2832/213	3740	151
PM 2832/253	3915	151
PM 2832/313	3740	151
PM 2832/353	3915	151
PM 3050/003	1540	270
Options**		
/113	85	
/763	225	
/773	310	
PM 3052/003	1720	270
Options: See PM 3050/003		
PM 3055/003	1585	270
Options: See PM 3050/003		
PM 3057/003	1765	270
Options: See PM 3050/003		
PM 3065/003	2055	290
Options: See PM 3050/003		

Continued . . .

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† *Training included in instrument purchase.*

†† *Does not include field installation or calibration.*

††† *Discounted to $2,995 through September 2, 1994.*

See page 4 for other footnote descriptions.

U.S. Prices April 1, 1994

Prices subject to change without notice. These prices apply to products purchased and used in U.S. only.

ITEM	PRICE	EXT WRTY[1]
PM 3067/003	2235	290
Options:		
See PM 3050/003		
PM 3070/003	2365	309
Options:		
See PM 3050/003		
PM 3072/003	2545	309
Options:		
See PM 3050/003		
PM 3082/003	2260	309
Options:		
See PM 3092/003		
PM 3084/003	2465	309
Options:		
See PM 3092/003		
PM 3092/003	3245	221
Options**		
/403	515	
/713	260	
/733	260	
/933	775	
PM 3094/003	3655	221
Options:		
See PM 3092/003		
PM 3335/003	2010	311
PM 3335/403	2420	311
PM 3335/503	2215	311
PM 3337/003	2190	311
PM 3337/403	2600	311
PM 3337/503	2395	311
PM 3340/403	20,085	803
PM 3340/803	20,470	803
PM 3350A/003	3350	376
PM 3350A/403	3760	376
PM 3350A/503	3760	376
PM 3352A/003	3530	376
PM 3352A/403	3940	376
PM 3352A/503	3940	376
PM 3355/003	4790	373
PM 3355/403	5200	373
PM 3355/503	5200	373
PM 3357/003	4970	373
PM 3357/403	5380	373
PM 3357/503	5380	373
PM 3365A/003	3865	382
PM 3365A/403	4275	382
PM 3365A/503	4275	382
PM 3367A/003	4045	382
PM 3367A/403	4455	382
PM 3367A/503	4455	382
PM 3375/003	4895	382
PM 3375/403	5305	382
PM 3375/503	5305	382
PM 3377/003	5075	382
PM 3377/403	5485	382
PM 3377/503	5485	382
PM 3382/003	4990	285
Options**		
/023	500	
/063	500	
/083	1000	
/403	500	
/423	1000	
/463	1000	
/483	1500	
/913	750	
/933	1250	
/973	1250	
/993	1750	
PM 3384/003	5490	285
PM 3384/003AU	5910	285
Options		
See PM 3382/003		
PM 3384E/103	7160	285
PM 3392/003	5990	285
Options		
See PM 3382/003		
PM 3394/003	6490	285
Options		
See PM 3382/003		
PM 3394/AUX	6740	285
PM 3394/083AU	7740	285
PM 3580/30	4885	280
PM 3580/31	5300	280
PM 3580/60	7275	280
PM 3580/61	7690	280
PM 3585/31	6190	346
PM 3585/61	8935	346
PM 3585/91	11,390	346
PM 5110M	430	147
PM 5132M	1355	249
PM 5133M	2535	316
PM 5133SM	2790	316
PM 5134M	3270	342
PM 5135/001	805	89
PM 5135/003	805	89
PM 5138/003	3700	285
PM 5138/023	4150	285
PM 5138/103	3700	
PM 5138/123	4150	
PM 5138/133	4150	
PM 5139/003	4300	340
PM 5139/023	4750	340
PM 5150/051	3455	285
PM 5150/053	3455	285
PM 5150/553	4490	285
PM 5190XM	3285	464
PM 5191M	4125	464
PM 5191SM	4350	464
PM 5192M	4935	464
PM 5192SM	5275	464
PM 5193M	5585	464
PM 5193SM	6005	464
PM 5193VM	7260	464
PM 5414V	1545	
PM 5414V+YC	2030	
PM 5414Y	1545	
PM 5414Y+YC	2030	
PM 5415	2520	
PM 5415+YC	3005	
PM 5415TN	4475	
PM 5415TN+YC	4960	
PM 5415TNS	5240	
PM 5415TNS+YC	5725	
PM 5415TX	3425	
PM 5415TX+YC	3910	
PM 5415TXS	4190	
PM 5415TXS+YC	4675	
PM 5418	3100	296
PM 5418+YC	3585	
PM 5418TN	5055	
PM 5418TN+YC	5535	
PM 5418TNS	5820	
PM 5418TNS+YC	6300	
PM 5418TNSIYC	7890	
PM 5418TX	4005	
PM 5418TX+YC	4485	
PM 5418TXI+YC	6070	
PM 5418TXS	4770	
PM 5418TXS+YC	5250	
PM 5514VMM	1500	229
PM 5514VMM+YC	2105	
PM 5712/08	2200	180
PM 5715/11	2490	180
PM 5781/001	8450	853
PM 5781/012	8450	853
PM 5781/021	9450	853
PM 5781/022	9450	853
PM 5786/00	5040	280
PM 5786B/00	5670	280
PM 6303A	1560	174
PM 6304/003	2285	241
PM 6304/023	2845	241
PM 6304/033	2695	241
PM 6304/043	2800	241
PM 6304/063	3360	241
PM 6304/073	3210	241
PM 6304/503	2645	241
PM 6304/523	3210	241
PM 6304/533	3060	241
PM 6304/543	3160	241
PM 6304/563	3725	241
PM 6304/573	3570	241
PM 6652C/011	3290	200
Gp 1 Options***		
/0--	NC	
/5--	815	
/6--	1035	
Gp 2 Options***		
/-1-	NC	
/-2-	300	
/-4-	835	
/-5-	1035	
/-8-	220	
Gp 3 Options***		
/--1	NC	
/--5	495	
/--6	455	
PM 6654C/011	3575	223
Options:		
See PM 6652/011		
PM 6662/011	780	144
Gp 1 Options***		
/0--	NC	
/4--	410	
Gp 2 Options***		
/-1-	NC	
/-3-	320	
Gp 3 Options***		
/--1	NC	
/--3	350	
/--6	310	
PM 6665/011	1065	124
Options:		
See PM 6662/011		
PM 6666/011	1170	124
Options:		
See PM 6662/011		
PM 6669/011	950	126
Options:		
See PM 6662/011		
PM 6671/011	1695	153
Gp 1 Options***		
/0--	NC	
/1--	NC	
/2--	NC	
/3--	NC	
/4--	NC	
/5--	NC	
/6--	NC	
Gp 2 Options***		
/-2-	300	
/-4-	840	
/-5-	1040	
/-8-	220	
Gp 3 Options***		
/--3	350	
/--4	450	
/--5	500	
/--6	460	
PM 6672/411	2150	155
Options:		
See PM 6671/011		
PM 6673/011	1420	141
Options:		
See PM 6671/011		
PM 6674/311	1685	151
Options:		
See PM 6671/011		
PM 6675/111	2070	151
Options:		
See PM 6671/011		
PM 6676/511	2025	156
Options:		
See PM 6671/011		
PM 6677/611	2510	156
Options:		
See PM 6671/011		
PM 6680/011	1745	222
GP 1 Options***		
/0--	NC	
/4--	570	
/6--	800	
/7--	2500	
GP 2 Options***		
/-1-	NC	
/-2-	270	
/-4-	760	
/-5-	940	
/-8-	200	
GP 3 Options***		
/--1	NC	
/--6	100	
PM 6685/011	1745	222
GP 1 Options***		
/0--	NC	
/4--	570	
/6--	800	
/7--	2500	292
GP 2 Options***		
/-1-	NC	
/-2-	270	
/-4-	760	
/-5-	940	
/-8-	200	
GP 3 Options***		
/--1	NC	
/--3	400	
/--6	100	
/--8	500	
HM 8400/01	519	
PF 8600/20	425	
PF 8600/21	175	
PF 8600/22	265	
PF8600/24	85	
PF 8600/26	620	
PF 8601	380	
PF 8601/40	135	
PF 8601/50	140	
PF 8601/60	150	
PF 8601/80	155	
PF 8603/20	640	
PF 8603/25	185	
PF 8610/30	1210	
PF 8611/30	1210	
PF 8612/30	1210	
PF 8613/30	1210	
PF 8613/32	1280	
PF 8613/82	135	
PF 8615/30	1210	
PF 8615/32	1280	
PF 8615/82	135	
PF 8616/32	1280	
PF 8616/82	135	
PF 8617/32	1280	
PF 8617/82	135	
PF 8618/32	1500	
PF 8618/82	145	
PF 8619/32	1445	
PF 8619/82	145	
PF 8620/30	1545	
PF 8620/31	1210	
PF 8620/32	1655	
PF 8620/33	1210	
PF 8620/81	55	
PF 8620/82	145	
PF 8620/83	65	
PF 8621/33	1320	
PF 8621/34	1860	
PF 8621/83	65	
PF 8622/32	2090	
PF 8622/82	145	
PF 8623/34	1790	
PF 8624/30	1545	
PF 8625/32	1610	
PF 8625/33	1210	
PF 8625/82	145	
PF 8625/83	65	
PF 8626/32	1975	
PF 8626/33	1545	
PF 8626/82	145	
PF 8626/83	65	
PF 8627/32	1655	
PF 8627/82	145	
PF 8628/32	1500	
PF 8628/82	135	
PF 8629/30	1515	
PF 8629/31	2910	
PF 8629/39	730	
PF 8630/33	1655	
PF 8630/34	1790	
PF 8630/83	75	
PF 8631/33	1655	
PF 8631/83	75	
PF 8632/33	1870	
PF 8632/83	85	
PF 8634/23	795	
PF 8635/33	2340	
PF 8635/34	2900	
PF 8635/83	75	
PF 8636/23	835	
PF 8636/24	1860	
PF 8637/33	2400	
PF 8637/34	2900	
PF 8637/83	85	
PF 8644/23	835	
PF 8645/33	2400	
PF 8645/83	85	
PF 8647/33	2140	
PF 8647/83	75	
PF 8652/20-UGK	3495	
PF 8652/25-UGK	5195	
PF 8653/31	205	
PF 8665/30	150	
PF 8665/31	55	
PF 8666/20	125	
PF 8669/20	265	
PF 8670/32	2090	
PF 8670/33	1645	
PF 8670/82	145	
PF 8670/83	75	
PF 8671/33	2140	
PF 8671/83	75	
PF 8672/34	2250	
PF 8673/34	1840	
PF 8675/33	1645	
PF 8675/34	1945	
PF 8675/83	75	
PF 8680/36	970	
PF 8681/36	1860	
PF 8682/36	2030	
PF 8683/36	1860	
PF 8684/36	1060	
PF 8685/26	2485	
PF 8686/26	1060	
PF 8690/00	160	
PF 8690/10	160	
PF 8711/30	1210	
PF 8711/32	1280	
PF 8711/82	135	
PF 8714/32	1540	
PF 8714/82	135	
PF 8715/32	1500	
PF 8715/82	135	
PF 8716/32	1500	
PF 8716/82	145	
PF 8717/32	1480	
PF 8717/82	140	
PF 8718/32	1540	
PF 8718/82	145	
PF 8719/32	1480	
PF 8719/82	140	
PF 8720/34	2250	
PF 8720/35	2090	
PF 8720/36	1785	
PF 8721/34	2110	
PF 8721/34V	2390	
PF 8722/33V	1455	
PF 8722/83	65	
PF 8723/32	1655	
PF 8723/82	145	
PF 8724/24	1600	
PF 8725/34	2765	
PF 8726/32	1610	
PF 8726/82	145	
PF 8727/34	1905	
PF 8728/34	2250	
PF 8728/35	1925	
PF 8729/32	1520	
PF 8729/82	130	
PF 8730/33	1655	
PF 8730/83	75	
PF 8740/32	1655	
PF 8740/82	140	
HM 8819/12	45	
PM 8819/30	85	
PM 8819/90	105	
PM 8819/91	215	
PM 8902A/001	295	
PM 8903A/001	640	
PM 8906/003	155	
PM 8906/004	155	
PM 8907/001	62	
PM 8907/003	62	
PM 8907/004	62	
PM 8907/008	72	
PM 8911/08	305	
PM 8912/08	310	
PM 8912/09	235	
PM 8914/001	45	
PM 8917/003	720	
PM 8918/002	176	
PM 8918/101	88	
PM 8918/202	202	
PM 8918/301	124	
PM 8926/591	80	
PM 8929/19	165	
PM 8929/29	165	
PM 8929/391	165	
PM 8929/491	115	
PM 8940/09Q	1055	
PM 8943A/003	1025	
PM 8953A/00	645	

Continued . . .

See page 4 for footnote descriptions.

U.S. Prices April 1, 1994

Prices subject to change without notice. These prices apply to products purchased and used in U.S. only.

ITEM	PRICE	EXT WRTY[1]
HM 8955	260	
PM 8957A	745	
PM 8958A	745	
PM 8959/001	800	
PM 8960/04	260	
PM 8961/001	335	
PM 8964/401	800	
PM 8969	310	
PM 8978/011	180	
PM 8978/021	180	
PM 8988	50	
PM 8989/001	165	
PM 8989/031	130	
PM 8991/04	540	
PM 8992/65	50	
PM 8992/80	60	
PM 8998	90	
PM 9001/001	70	
PM 9001/091	90	
PM 9001/201	85	
PM 9001/291	100	
PM 9002/001	30	
PM 9003/001	65	
PM 9010/001	75	
PM 9010/091	100	
PM 9010/201	95	
PM 9010/291	115	
PM 9011/001	80	
PM 9020/001	100	
PM 9020/091	120	
PM 9021/001	110	
PM 9051	25	
PM 9061	25	
PM 9063/001	30	
PM 9067	25	
PM 9071	60	
PM 9072	60	
PM 9074	25	
PM 9075	25	
PM 9076/01	70	
PM 9076/02	70	
PM 9080/001	145	
PM 9081/001	26	
PM 9082/001	26	
PM 9083/001	41	
PM 9084/001	36	
PM 9085/001	36	
PM 9086/001	41	
PM 9087/002	93	
PM 9090/001	36	
PM 9091/001	62	
PM 9092/001	52	
PM 9093/001	36	
PM 9094/001	62	
PM 9094/301	70	
PM 9095/001	36	
PM 9096/001	178	
PM 9098/001	83	
PM 9099/001	41	
PM 9100/001	145	
PM 9100/091	170	
PM 9102/001	35	
PM 9190/02	460	
PM 9193/02	460	
PM 9210	340	
PM 9212	295	
PM 9218A/013	65	
PM 9244	95	
PM 9245	95	
PM 9246/04	200	
PM 9249/01	205	
PM 9264/01	120	
PM 9265/01	150	
PM 9266/03	60	
PM 9266/04	43	
PM 9267/01	200	
PM 9278/02	105	
PM 9280/04	320	
PM 9355/09	1290	
PM 9355/09Q	1290	
PM 9372/001	285	
PM 9372/901	155	
PM 9381	825	
PM 9515	80	
PM 9536/041	50	
PM 9536/501	80	
PM 9537/01	50	
PM 9538	40	
PM 9539/01	50	
PM 9541A	110	
PM 9542A	330	
PM 9542 SMD	130	
PM 9543	450	
PM 9544	810	
PM 9545	810	
PM 9546	310	
PM 9548	620	
PM 9549	460	
PM 9551	100	
PM 9559	230	
PM 9560	190	
PM 9561	190	
PM 9561G	165	
PM 9563	230	
PM 9564	160	
PM 9565	570	
PM 9566	400	
PM 9579	1575	
PM 9581/01	100	
PM 9584/02	90	
PM 9585/01	50	
PM 9587	115	
PM 9588/01	360	
PM 9596/09	90	
PM 9598/09	90	
PM 9599/09	225	
PM 9604/00	310	
PM 9605/00	350	
HM 9606/00	175	
HM 9606/01	165	
PM 9606/01	200	
HM 9606/02	185	
PM 9606/02	265	
HM 9606/03	175	
PM 9607/00	320	
PM 9608B/00	410	
PM 9609	100	
PM 9610/01	770	
PM 9611/01	140	
PM 9611/80	145	
PM 9612/01	330	
PM 9613/01	285	
PM 9619	1045	
PM 9621/00	570	
PM 9622/00	170	
PM 9622/02	170	
PM 9622/03	100	
PM 9623	420	
PM 9624/00	840	
PM 9625/00	2600	
PM 9626/00	635	
PM 9626/02	635	
PM 9627	150	
PM 9628/00	160	
PM 9629/80	310	
PM 9669/01	120	
PM 9669/02	180	
PM 9672/70	110	
PM 9678B/01	300	
PM 9690/01	845	
PM 9691/01	1045	
PM 9693/00	350	
PM 9695/00	500	
PM 9696B/00	460	
PM 9697/00	220	
PM 9856/05	70	
PM 9857/05	70	
PM 9857/15	70	
PM 9857B/05	70	
PM 9875A/01	90	
PM 9875B/01	70	
PM 9920/00	50	
PM 9920/05	50	
PM 9930A/03	125	
PM 9930A/05	125	
SM 5000	1185	
SM 5000/901	755	

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General Index

1 Introduction **I**
New Products II
Indexes XIII

2 Oscilloscopes **1**
Selection Guide 2
Introduction 3
CombiScope Instruments 6
Analog Oscilloscopes 25
Accessories 36
Software 47

3 ScopeMeter Test Tools **49**
ScopeMeter Test Tools 50
Selection Guide 54
Automotive ScopeMeter
Test Tools 55
Accessories 56

4 System & Bench Multimeters **61**
Selection Guide 62
System Multimeters 63
Bench/Portable Multimeters 88
Digital Voltmeters 94
Analog Voltmeters 97

5 RCL Meters **98**

6 Handheld Multimeters **103**
Selection Guide 104
Handheld Multimeters 105

7 Multimeter Accessories **133**
Accessory Charts 134
Test Leads, Probes & Clips 137
Current Clamps 140
Temperature Probes 144
Protection & Storage 147
Specialty Accessories 151

8 Counters & Timer/Counters **155**
Selection Guide 156
Introduction 157
System Timer/Counters 159
Benchtop Timer/Counters 172
Multifunction Counters 178

9 Data Acquisition **191**
Selection Guide 192
Introduction 193
Data Loggers 194
Computer Front Ends 204
I/O Options 209
Software 212

10 Digital Thermometers **218**

11 LAN Products **217**

12 Calibration Instruments **221**
Selection Guides 222
Calibration Instruments 224
Automated Metrology 246
Standards Instruments 254

13 Logic Analyzers **271**
Introduction 272
Logic Analyzers 273
Processor Support 279
Bus Analysis 282

14 Digital Troubleshooting Tools **282**
Digital Troubleshooters 284
Micro-System Troubleshooters .. 291
Dynamic Troubleshooter 293
Interface Pods 295

15 Instrumentation Systems
GPIB Selection Guide 298
Introduction 299
Software Selection Guide 301
LabWindows 302
Instrument Drivers Software 304
Modular GPIB Switching System 307
Switch Controller/Scanner 314

16 Power Supplies **315**

17 Signal Sources **320**
Selection Guide 320
Arbitrary Waveform Generator ... 321
Function Generators 326
Pulse Generators 351

18 TV & Video Pattern Generators **359**

19 General Accessories **381**
Adapters 382
Cables 383
Rack Mounts 387

20 Customer Support Services **393**
Repair & Calibration 394
Standard Price Repair 395
Replacement Parts 395
Extended Warranty Service 395
Customer Training 396

21 Glossary **397**

22 Ordering Information **409**
Working with Fluke 410
Power Cords 410
Education Support Programs 411
Technical Literature 412
U.S. Sales & Service Offices 414
International Sales Offices 415
International Service Centers 419
U.S. Distributors 424
Rental Companies 424

Call Guide Inside back cover

NEW

Indentifies new products appearing in this years catalog.

GPIB
IEEE-488

Indicates that an instrument is available with a GPIB (General Purpose Interface Bus)/IEEE-488 communications interface bus. GPIB is equivalent to IEEE-488/IEC-6251.

SCPI
GPIB
IEEE-488

Indicates that an instrument is available with a GPIB (General Purpose Interface Bus)/IEEE-488 communications interface bus, and complies with the internationally standardized command language for electronic instruments – SCPI (Standard Commands for Programmable Instrumentation). GPIB is equivalent to IEEE-488/IEC-6251.

Alphabetical

Alphabetical

A

- Abbreviations & Symbols ... 397
- AC Calibrator ... 224, 232, 237
- AC Current Probes ... 140-144
- AC Millivoltmeter ... 94
- ACCESS.bus Support Package ... 282
- Accessories
  - Adapters, General ... 154, 382
  - Attenuators ... 46, 382
  - Battery Eliminator ... 154
  - Cables ... 47, 383-386
  - Cases ... 148-150
  - Connectors ... 147
  - Current Probes ... 140-144
  - Feedthrough Termination ... 382
  - Filter ... 382
  - Holsters ... 147
  - Inductive Pickup ... 154
  - Miscellaneous ... 381-392
  - Multimeter ... 119-134
  - Oscilloscope ... 36-46
  - Probes ... 39-44, 140-147
  - Protection & Storage ... 147
  - Rack Mounts ... 387
  - RF ... 152
  - ScopeMeters ... 56-60
  - Shunts ... 144, 245, 262
  - Specialty ... 151
  - Temperature Probes ... 144-147
  - Test Leads ... 137-140, 386
- AC/DC Current Shunt ... 144, 245, 262
- AC/DC Transfer Standard ... 260
- AC Measurement Standard ... 254
- AC Voltage Calibrators ... 224, 232, 237, 244
- Acquisition System, Data ... 191-214
- Agreement, Service ... 395
- Alligator Clips ... 138
- Alternating Voltage Calibrator ... 224, 232, 237, 269
- Amplifiers ... 224, 241, 243
- Amplifier, Isolated ... 43
- Amplifier, Precision Power ... 224, 241, 243
- Amplifier, Transconductance ... 243
- Analog, Electronic Multimeter ... 97
- Analog/Digital Multimeters 76, 88, 116-125, 129
- Analog/Digital Storage Oscilloscopes ... 6-24
- Analog Oscilloscopes ... 25-35
- Analyzers, Logic ... 271-282
- Application Assistance ... 395
- Application Training ... 396
- Arbitrary Waveform Generator ... 321
- Asynchronous Signature Probe ... 285
- AT Software ... 306
- Automated Metrology ... 246
- Automated PCB Tester ... 283
- Automated Test Equipment (ATE) ... 295
- Automatic RCL Meters ... 98, 100
- Automotive Multimeters ... 111-114
- Automotive ScopeMeter Test Tool ... 56

B

- Battery Charger ... 56
- Battery Eliminator ... 154
- Bead Thermocouple ... 145, 216
- Bench-Battery Multimeters ... 76, 88, 90, 92
- Bench/Portable Multimeters ... 66, 70, 76, 88-93
- Bench/System Multimeters ... 62-87
- Benchtop Counters ... 172, 176
- BNC Attenuator ... 382
- BNC Banana Adapter ... 154, 382
- BNC Coaxial Cables ... 383
- BNC Feed Through Termination ... 382-383
- Board Test Systems ... 283-296
  - Digital Troubleshooter ... 284
  - Dynamic Troubleshooter ... 293
  - Interface Pods ... 295
  - Micro-System Troubleshooters ... 291
  - Spectrum TX ... 284
  - Test Systems ... 287
- Boundary Scan Analysis Package ... 282
- Bus Analysis ... 282

C

- Cables ... 47, 383-386
  - Analog Interface ... 314
  - BNC ... 383
  - IEEE-488 ... 383
  - Low Thermal ... 386
  - Ribbon ... 385
  - RS-232C ... 47, 384
- CableMapper, LAN ... 220
- CableMeter, LAN ... 219
- Calibration Documentation ... 410
- Calibration: Philosophy & Practice ... 231
- Calibration Services ... 394
- Calibration Software ... 229, 246-253
- Calibration Instruments ... 221-270
  - Alternating Voltage ... 224, 232, 237, 269
  - Calibrators ... 224, 232-242, 244, 269
  - Direct Voltage ... 224, 232, 235, 244, 269
  - Multimeter ... 224, 232, 269
  - Portable ... 269
  - Programmable Alternating Voltage ... 224, 232
  - Programmable Direct Voltage ... 224, 232, 235
  - Resistance ... 224, 232, 240, 269
- Calibration Workstation ... 229
- Camera, Oscilloscope ... 46
- Carrying Cases
  - Calibrator ... 257, 262, 263
  - Counter ... 190
  - DMM ... 147-150
  - Micro-System Troubleshooters ... 292
  - Oscilloscopes ... 45
  - ScopeMeter ... 56-57
- Cart, Oscilloscope ... 45, 46, 386
- CIMPAC Software ... 213
- Circuit Board Tester ... 283
- Clamp-on Current Probes ... 140-144
- Color Pattern Generator ... 359-371
- CombiScope Instruments ... 6-24
- Computer Front End ... 204
- Consulting Services ... 393-396
- Contracts, Service ... 395
- Converter, DC-DC, Oscilloscope ... 44
- Converter, Thermal ... 269
- Counters ... 155-190
  - Accessories ... 381
  - Battery Powered ... 172, 176, 178, 183, 187
  - Benchtop Timer/ ... 172. 176
  - Frequency ... 178,183, 187
  - Frequency Only ... 187
  - Multifunction ... 178, 183,
  - Programmable Timer/ ... 159, 165, 169, 172
  - Reciprocal Timer/ ... 169, 172, 176, 183
  - System Timer/ ... 159, 165, 169, 172
  - TimeView Software ... 166
  - Universal Frequency ... 178, 183
- Current Calibrators & Standards ... 224, 232
- Current Master™ ... 140-144
- Current Probes ... 50, 51, 127, 128
- Current Shunt ... 144, 245, 262
- Customer Service ... 393-396
- Customer Support ... 393-396
- Customer Training ... 396

D

- Data Acquisition ... 191-214
  - Data Acquisition Unit ... 194
  - Data Bucket ... 194
  - Data Loggers ... 194, 196, 200
  - Data Logging System ... 354, 369, 374
  - Extender Chassis ... 211
  - Front Ends ... 204
  - Options ... 209
  - Software ... 212
  - Systems ... 200
  - Wireless ... 198
- dB Voltmeters ... 76, 88, 116-125, 129
- DC Current Calibrators ... 224, 232
- DC Reference Standard ... 254, 259, 260, 263
- DC Voltage Calibrator . 224, 232, 235, 244, 269
- Digital/Analog Multimeter . 76, 88, 116-125, 129
- Digital Counters ... 156
- Digital Multifunctional Multimeter ... 76, 85, 126, 129
- Digital Multimeters ... 63-93
- Digital Pressure/Vacuum Module ... 151
- Digital Storage Oscilloscopes ... 6-24
- Digital Test System ... 287
- Digital Thermometers ... 215-216
- Digital Troubleshooting Tools ... 283-296
- Digital Voltmeters ... 62, 94, 104, 109
- Direct Voltage Calibrator ... 224, 232, 235
- Direct Voltage Maintenance Program ... 264
- Distributors, U.S. ... 424
- Divider, Reference ... 266
- Dividers & Standards Equipment . 245, 266-268

Alphabetical

- DMM, RS-232 76, 80
- Drivers, Software 304
- DSOs 6-24
- Dual Analysis Logic Analyzer 273
- Dual Display Multimeter 66
- Dynamic Troubleshooter 293

E

- Education Support Programs 411
- Electronic Counter/Timers 76, 169, 172, 176
- Electronic Multimeter 97
- Emulators, Microprocesser 287, 293
- Extender Chassis 203, 211
- Extended Warrant Service 395

F

- FET Probe 44
- Frequency Only Counters 187
- Frequency Probes 152
- Front End, Computer 204
- Function Generators 326-350
- Functional Printed Circuit Board (PCB) Testers 287
- Fuses 135

G

- General Accessories 381-392
- General Purpose Oscilloscope 2
- Generator, Pulse 351-358
- Generator, RF 326-333
- Generator, Signal 326-333
- Generator, TV & Video 359-380
- Glossary of Terms 397
- GPIB/IEEE Instrumentation Systems 63, 313
- GPIB/IEEE-488 Selection Guide 298
- GPIB Instruments 298
- GPIB PC Interface Card 306
- GPIB PS/2 Interface Card 306
- GPIB Software 301-306
- GPIB Switching System 308

H

- Handheld Multimeters 103-132
- Handheld Thermometer 215
- Harmonics Training Video 107, 142
- Helios I & Helios Plus 204
- High Frequency Probes 152
- High Frequency Thermal Converter 269
- High Resolution Frequency Counters 169, 172
- High Voltage Probe 153
- Holster, Multipurpose DMM 147
- Hydra LabView Driver 213
- Hydra LabWindows Driver 213
- Hydra Series 196

I

- IBM-PC Software 306
- IEEE-488 Cables 383
- IEEE-488 Instruments 298
- Inductive Pickup 154
- Infrared Temperature Probe 144
- Instrumentation Systems 297-314
- Instrument Drivers 304
- Intelligent Computer Front End 204
- Interface Pods 295, 296
- International Locations 415
- Isolation Amplifier, Oscilloscope 43

K

- Kelvin-Varley Divider 267

L

- Labtech Notebook Software 212
- LabView Driver 213
- LabWindows® Driver 302
- LAN Products 215-220
- LAN CableMapper 220
- LAN CableMeter 219
- LANMeter 217
- Leads, Low Thermal 235, 386
- Leads, Test 59, 137-140, 386
- LF Synthesizer 326-334
- Literature, Technical 412
- Logger, Data 194
- Logger, Wireless 198
- Logic Analyzers 271-282
  - Boundary Scan 282
  - BuBus Analysis 282
  - Dual-Analysis 283
  - Microprocessor Support 279-281
  - µP Circuits 287

M

- Matrix Switching 307
- Medical (X-Ray) 130
- MET/CAL 250
- MET/TRACK 246
- Meter, Millivolt AC 94
- Meter, Peak Reading 116
- Metrology Services 270
- Microprocessor Support 279-281
- Microprocessor Troubleshooters 283-296
- Micro-System Pods 295, 296
- Micro-System Troubleshooter 291
- Milliamp Second (mAs) Meter 130
- Modular GPIB Switching System 307
- Module Exchange Program 399
- Multifunction Frequency Counter 178, 183
- Multimeters 61-97
  - Accessories 133-154
  - Analog/Digital 76, 88, 116-125, 129
  - Automotive 55, 111-114
  - Bench/Portable 66, 70, 76, 88-93
  - Bench/System 62-87
  - Current Master™ 105
  - Digital 63-93
  - Digital/Analog 76, 88, 116-125, 129
  - Dual Display 66
  - Handhelds 103-132
  - Multifunction 76, 85, 126, 129
  - Rack Mount Kits 387
  - RS-232C 63, 66, 76, 80
  - Scanning 196
  - System 62, 63
  - Thermal RMS 80, 94
  - Watertite 123, 125

N

- National Stock Numbers see product pages
- Non-Storage Oscilloscopes 25, 30, 34
- Null Detector, High Impedance Voltmeter 268

O

- Ohmmeter, Digital 62, 104
- Ordering Information 409
- Oscilloscope Accessories 36-46
- Oscilloscopes 1-48
  - Accessories 36-46
  - Analog 25, 35
  - Combination Analog & Storage 6-24
  - Non-Storage 25, 30, 34
  - Real Time 30
  - ScopeMeters 49-60
  - Software 47-48
  - Storage, Digital 6-24

P

- Parts Service 395
- PCB Automated Test Equipment 287
- PCB Troubleshooters 283-296
- PCB Exchange Services 395
- PC Software 306
- Peak Reading Meter 116
- Platinum Resistance Thermometer 86
- Pods, Micro-System Troubleshooter 295-296
- Portable Multimeters 88, 90, 92
- Pouches, Oscilloscopes 45
- Power Cords 410
- Power D-A Converters 204
- Power Supplies, Programmable 315-318
- Precision Power Amplifier 224, 241, 243
- Pressure/Vacuum Modules 151
- Preventive Maintenance Services 395
- Probes
  - Current, Clamp-on 140-144
  - Data Hold 153
  - FET 44
  - High Frequency 152
  - High Voltage 153
  - Leads, Test 59, 137-140, 386
  - Oscilloscope 36-44
  - RF 152
  - Signature 292
  - Temperature 144-147, 216
  - Touch-Hold 153
- Processor Support 279-281
- Programmable DMM 63, 70-87, 94
- Programmable Front End 204
- Programmable RF Generator 374

- Programmable
  - Timer/Counters 159, 165, 169, 172
- Protection & Storage 147-150
- PS/2 Software 306
- Pulse Generators 351-358

Q

- QuickStart 45 69

R

- Rack Mounts 46, 387
- RCL Meter, Automatic 98, 100
- Recalibration Services 394
- Reciprocal Timer/Counters 169, 172, 176, 183
- Reference Divider 266, 267
- Reference Standards 254, 259, 260, 263
- Reference Standard, Alt Voltage 232, 269
- Rental Companies 424
- Repair Services 395
- Replacement Parts 395
- Resistance Calibrators 224, 232, 240, 269
- Resistance Standard 263
- RF Probe 152
- RF Generator 326-334
- Ribbon Cable 385
- RS-232C Cables 47, 384
- RS-232C Instruments see product indexes
- RTD Temperature Probe 86

S

- Sales Offices 415-424
- Sales Offices International 415
- Sales Offices U.S. 414
- Scanners 210, 314
- Scanning Multimeters 196
- ScopeMeter Test Tools 49-60
- ScopeMeter Accessories 56-60
- ScopeMeter, Automotive 55
- Self-Maintenance Services 395
- Serial Data Adapter 282
- Series 18 129
- Service 393
- Service Agreements 395
- Service Centers 414
- Service Training 396
- Sheathed Thermocouple Probes 146, 216
- Shunt, Current 58, 144, 245, 262
- Signal Sources 319-358
  - Arbitrary Waveform Generator 321
  - Function Generators 326-350
  - Low Distortion LF Generators 349, 350
  - Pulse Generators 351-358
  - RF Generators 326-334
  - TV & Video Generators 359-380
- Signature Analysis 285
- SMD Adapter 98, 100
- Software
  - AnyWave™ 301, 325
  - AT 306
  - BASIC, Visual 306
  - C 306
  - Calibration 229, 246, 253
  - CIMPAC 213
  - DSOCOM 47, 301
  - GPIB 301
  - Helios Logger 214
  - Helios Toolbox 213
  - Hydra Starter 212
  - IBM-PC 306
  - LabTech Notebook 376
  - LabView 213
  - LabWindows 213, 301, 302
  - Language Compiler 292
  - MET/CAL 250
  - MET/TRACK 246
  - Oscilloscopes 47
  - PC 306
  - QuickStart 45 69
  - SPECTRUM TX 284
  - Telegnostics 48, 301
  - TimeView 166, 301
  - Toolbox, Helios 213
  - Utility 292
  - Wireless 199
- Spare Parts 395
- Specialty Accessories 151-154
- Standard Price Repair 395
- Standards, Reference 254, 259, 260, 263
- Standards, Transfer 260
- Storage Oscilloscopes 6-24
- Storage & Protection 147-150
- Surface Temperature Probe 146, 216
- Switch Controller/Scanner 314
- Synthesized Function Generators 326-350
- System Multimeters 62-87
- System Timer/Counters 159, 165, 169, 172
- System 21 GPIB Switching System 307

T

- Technical Literature 412
- Telegnostics Software 48, 300
- Temperature Controlling System 191-214
- Temperature Meas System 86
- Temperature Probes 144-147, 215
- Temperature Scanner 204, 314
- Tester, Functional PCB 287
- Tester, Logic Board 283
- Test Clips 137-140
- Test Leads 59, 137-140
- Test Probes 138
- Test Systems, Digital 287
- Thermal Converter 269
- Thermal RMS Digital Multimeter 80
- Thermal RMS Voltmeter 80, 94
- Thermal Transfer Standard 260
- Thermocouple
  - Probes 216
  - Surface 216
  - Bead 216
  - Sheathed 216
- Thermometer, Digital 215
- Thermometer, Handheld 215
- Timer/Counter, System 159, 165, 169, 172
- Toolbox, Helios Software 213
- Touch and Hold Probe 153
- Traceability 394
- Training 396
- Transconductance Amplifier 243
- Troubleshootering Test Tools 283-296
- Troubleshooter, Dynamic 293
- Troubleshooter, Interface Pods 295, 296
- Troubleshooters, Micro-System 291
- Troubleshooters, Multimeters 104
- Troubleshooters, Software 284
- True-RMS Voltmeter 62, 104
- TV Signal Generater 361
- TV & Video Generator 359-380

U

- U.S. Sales Offices 414
- µP Board Tester 283

V

- Vacuum Modules, Pressure 151
- Video Harmonics Training 107
- Video & TV Generators 359-380
- Video Line Selector, Oscilloscope 43
- VMEBus Support Package 282
- Voltage Calibrator,
  - Direct 224, 232, 235, 244, 269
- Voltage, Divider, Kelvin-Varley 267
- Voltage/Current Calibrator 224, 237
- Voltage Divider, High Voltage 196, 199
- Voltage Standards 188-197
- Voltmeters
  - Accessories 133, 381
  - BCD Programmable 85
  - Calibration 62
  - Capacitance 76
  - Conductance 62, 104
  - Digital 62,104
  - dB 54, 92
  - Frequency 116, 126, 129
  - Handheld 104, 108
  - High Impedance/Null Detector 268
  - Low Resistance Measurement 63, 70-87
  - Milliamp Second (mAs) 130
  - Thermal AC RMS 80, 94
  - Wideband True RMS 94

W

- Warranty 395
- Wideband Digital Voltmeter 94
- Wireless Logger, Hydra 198
- Wireless Options 199
- Workstation, Calibration 229
- Wow & Flutter Meter 380

Model Numbers

10*	Digital Voltmeter	108
11*	Digital Voltmeter	108
12*	Digital Voltmeter	108
21-2*	Handheld Multimeter	119
23-2*	Handheld Multimeter	119
25*	Handheld Multimeter	123
27*	Handheld Multimeter	123
29-2*	Handheld Multimeter	121
31*	Current Master™	105
33*	Current Master™	105
37*	Bench/Portable Multimeter	88
45*	Dual Display Multimeter • †	66
51*	Digital Thermometer	215
52*	Digital Thermometer	215
70-2*	Handheld Multimeter	119
73-2*	Handheld Multimeter	119
75-2*	Handheld Multimeter	119
77-2*	Handheld Multimeter	119
78	Automotive Meter	111
79-2*	Handheld Multimeter	121
80AK	Thermocouple Adapter Plug	147
80CJ*	Thermocouple Plugs	147, 216
80CK*	Thermocouple Plugs	147, 216
80i-400*	AC Current Probe	141, 142
80i-410*	Clamp-on DC/AC Current Probe	57, 141, 142
80i-600*	AC Current Probe	141, 143
80i-1000s	AC Current Probe	57, 143
80i-1010*	Clamp-on DC/AC Current Probe	57, 141, 143
80i-kW	Clamp-on Current/Power Probe	57, 141, 143
80J-10*	AC/DC Current Shunt	58, 144
80K-6*	High Voltage Probe	153
80K-40*	High Voltage Probe	153
80PK-1*	Bead K Thermocouple	145, 216
80PK-2A*	Sheathed K Thermocouple	145, 216
80PK-3A*	Surface K Thermocouple	145, 216
80PK-4A*	K-Type Air Probe	145, 216
80PK-5A*	K-Type Piercing Probe	145, 216
80PK-6A*	K-Type Exposed Junction Probe	145, 216
80T-H*	Touch and Hold Probe	153
80T-IF	Infrared Temperature Probe	145
80TK*	Thermocouple Module	145
80T-150U*	Temperature Probe	60, 146
83*	Handheld Multimeter	116
83RF*	RF Probe	152
85*	Handheld Multimeter	116
85RF*	RF Probe	152
87*	Handheld Multimeter	116
88*	Automotive Multimeter	114
93*	ScopeMeter Test Tool	50
95*	ScopeMeter Test Tool	50
97*	ScopeMeter Test Tool	50
97/AUTO	ScopeMeter Automotive Test Tool	55
343A	DC Voltage Calibrator	244
515A	Portable Meter Calibrator	269
610	LAN CableMapper	220
650	LAN CableMeter	217
652	LAN CableMeter	217
670	LANMeter	219
720A	Kelvin-Varley Voltage Divider	267
732B	DC Reference Standard	259
734A	DC Reference Standard	259
742A Series	Resistance Standards	263
742A-7002	Transit Case	263
752A	Reference Divider	266
792A	AC/DC Transfer Standard	260
845AB/AR	Voltmeter/Null Detector	268
900FT	Dynamic Troubleshooter †	293
2201A	Scanner Extender Chassis •	314
2205A	Switch Controller/Scanner •	314
228X Series	I/O Options	209
2281A	Extender Chassis • †	203, 208, 211
2285B	Data Logger • †	200
2286A	Data Logging System • †	200
2287A	Helios Plus Computer Front End	204
2289A	Helios-I Computer Front End †	204
2289A-901	Helios Toolbox	213
2289A-902	CIM-PAC Software (Helios)	213
2289A-903	Helios Logger Software	214
22810A	Helios Computer Front End †	208
22811A	Helios Computer Front End †	208
2620A	Data Acquisition Unit • †	194
2620A-100	Extra I/O Connector Set	199
26XXA-600	Hydra Portable Battery Pack	199
26XXA-901	Hydra Logger Software	212
2625A	Data Logger †	194
2625A/WL	Wireless Logger	198
2625A/WL -700	Wireless Base Station Package	198
26X5A/WL -701	Hydra Wireless Conversion Kit	199
26X5A/WL -702	Wireless Modem	199
26X5A/WL -703	Wireless Logger Power Kit	199
26X5A/WL -704	Wireless Logger DC Power Kit	199
26X5A/WL -902	Wireless Logger for Windows Software Package	199
2635A	Hydra Data Bucket	194
5100A -7003K	Carrying Case	234
5100A -7005K	Extender Kit	234
5100B	Meter Calibrator • †	232
5101B	Meter Calibrator with Tape Deck • †	232
5102B	Meter Calibrator (military) •	232
5130A	Calibration Workstation • †	229
5200A	Programmable AC Calibrator •	237
5200A -7015K	Extender Board Kit	239
5205A	Precision Power Amplifier • †	241
5220A	Transconductance Amplifier • †	243
5440A-7001	Storage Module	236
5440A-7002	Low Thermal Cables	236, 258, 386
5440B	Direct Voltage Calibrator • †	235
5700A	Precision Meter Calibrator • †	224
5725A	Precision Power Amplifier •	224
5790A	AC Measurement Standard •	254
8010A*	Digital Multimeter	92
8012A*	Digital Multimeter	92
8025B	Handheld Digital Multimeter	125
8050A*	Digital Multimeter	90
8060A*	Handheld Digital Multimeter	126
8062A*	Handheld Digital Multimeter	126
8505A	Digital Multimeter • †	80
8506A	Digital Multimeter w/Thermal RMS • †	80
8520A	Digital Multimeter •	85
8520A/AS-1	MATE Digital Multimeter •	86
8520A/PRT	Precision Temperature System •	86
8522A	Digital Multimeter	85
8840A*	Digital Multimeter •	70
8840A/AF	Digital Multimeter •	70
8842A*	Digital Multimeter •	70
8920A	Digital Voltmeter (PTI I/F) •	94
8921A	Digital Voltmeter (PTI I/F) •	94
8922A	Digital Voltmeter (PTI I/F) •	94
892XA-0X	Digital Voltmeter Options	96
892XA-52X	Digital Voltmeter Options	96
8XXXA-522	Interface Options	96
9000 Series	Micro-System Troubleshooter Systems • †	291
9000A-006	Asynchronous Signature Probe Option	292
9000A-900	Transit Case	292
90XX Series	Microprocessor Interface Pods	295
9005A	Micro-System Troubleshooter • †	291
9010A	Micro-System Troubleshooter • †	291
9010A-92X	Language Compiler Software	291
9020A	Micro-System Troubleshooter • †	291
9100FT Series	Troubleshooting Test Systems • †	287

Index

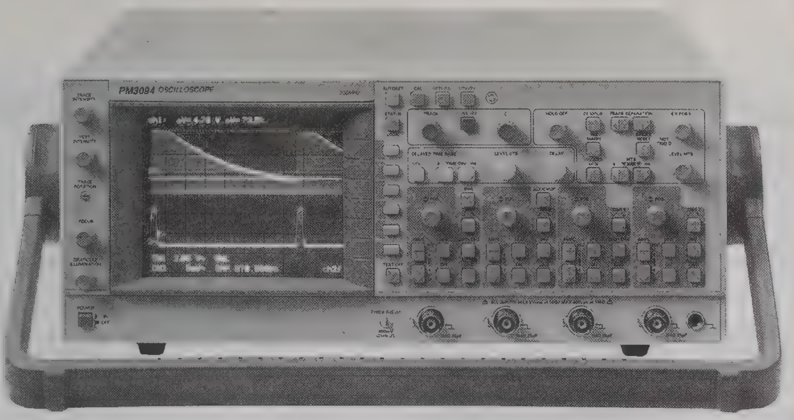
9110FT Series Digital Troubleshooters • † 284
9110FT-906 SPECTRUM-TX Troubleshooting Software 284
9132FT Memory Interface Pod Support Package 296
A22-300 Transit Case (2280B Series) . 203
A40 (any) Current Shunt Series 262
A55 (any) Thermal Converter for 540B . 269
A55-110 Accessory Lead Kit 269
A81* Battery Eliminator 154
AC20* Industrial Test Clips 60, 137
AC70A* Alligator Clips for TL70s 138
AC75* Banana Jack-Alligator Clips ... 139
AC80* Hook-Style Test Clips 60, 137
AC83* Pin-Grabber Test Clips 137
AC85* Large Jaw Alligator Clips 138
AC89* Insulation Piercing Clips 137, 138
C10* Holster 110, 147
C12* SoftCase 148
C17Y* DuraCase 150
C20* Hard Carrying Case 149
C25* Soft Carrying Case 148
C28Y* DuraCase 150
C30* Replacement Holster 107, 147
C40* Carrying Case 148
C41 Storage Case (A40 Shunts) ... 262
C42 Wireless Logger Soft Carrying Case 195
C50* Soft Carrying Case 148
C55 Carrying Case 269
C70Y/C70G* Multipurpose Holster 147
C75* Test Lead Case 56, 148
C81G/C81Y* Multipurpose Holster 147
C86* Hard Carrying Case 149
C90* Soft Carrying Case 148
C95* ScopeMeter Soft Case 57
C97* ScopeMeter Hard Case 57
C100* Universal Hard Carrying Case 149
C800 Hard Storage Case 149
FUSE Replacement DMM Fuses 134
HM 9606 Rack Mount 387, 392
MEE-7001 3" Rack Adapter 244
MIS-7011K Extender Card 84
MIS-7013K Bus Interconnect 84
MIS-7190K Static Controller 84
M00-200-611* 3^{1}/2" Rack Adapter, Offset ... 388
M00-200-612* 3^{1}/2" Rack Adapter, Center .. 388
M00-200-613* 3^{1}/2" Rack Adapter, Dual 388
M00-200-634 Rack Mount Kit 389
M00-260-610 18" Rack Slides 391
M00-270-610 20" Rack Slides 391
M00-280-610 24" Rack Slides 391
M04-205-600 5^{1}/4" Rack Adapter 388
M05-205-600 5^{1}/4" Rack Adapter 390
M07-200-603 7" Rack Adapter, Side by Side 390
M08-205-600 8^{3}/4" Rack Adapter 390
M10-205-600 10^{1}/2" Rack Adapter 390
PF 86XX Series Logic Analyzer Personality Adapters & Disassemblers 278, 279
PF 87XX Series Logic Analyzer Personality Adapters & Disassemblers .. 279
PF 8680 GPIB/IEEE-488/IEC-625 Bus Analysis Package 282
PF 8681 12C-ACCESS.bus Support Package 282
PF 8682 Serial Data Adapter 282
PF 8683 JTAG/IEEE-1149.1 Boundary Scan Protocol Analysis Package 282
PF 8684 VMEBus Support Package 282
PF 8685 IBM System/360/370 I/O Bus Analyzer Package 282
PF 8686 PC/AT-Bus Support Pacage .. 282
PM 21XX System 21 Modular GPIB Switching System • 308
PM 2101 IEEE-488/IEC Interface/ PSU• 307, 308
PM 2120 Universal Switching Unit 307, 309
PM 2121 Low Level Switching Unit 307, 309
PM 2122 Coaxial Switching Unit ... 307, 309
PM 2124 High Current Switch 307, 309
PM 2130 Digital Input/Output Unit 307, 310
PM 2131 Digital Input Unit 307, 310
PM 2132 Digital Output Unit 307, 310
PM 2140 Analog Input Unit 307, 311
PM 2141 Analog Output 307, 311
PM 2150 User-Adaptable Unit 307, 312
PM 2160 Temperature Unit for Pt 100 .... 307, 311
PM 2190 Display Module 312
PM 2191 Terminal Adapter 312, 382
PM 2192 Extension Cable 312, 383
PM 2193 Rack Mount 312, 387, 392
PM 2194 Blank Panels for Rack Mount Kit 312
PM 2198 Additional Power Supply 312
PM 2201 Series GPIB PC Interface Card and Software • 305, 306
PM 2202 Series GPIB PS/2 Interface Card and Software • 305, 306
PM 2250 TestTeam Plus Software • 303
PM 2251 Advanced Analysis • 303
PM 2252 Run-Time System 303, 304
PM 2255 Instrument Drivers • 47, 302, 304
PM 2270 PC Communication Software 47, 60
PM 2273 AnyWave™ Software 47, 325
PM 2295/05 GPIB/IEEE-488 Cable • 0.5m 383
PM 2295/10 GPIB/IEEE-488 Cable • 1m ... 383
PM 2295/20 GPIB/IEEE-488 Cable • 2m ... 383
PM 2505 Electronic Multimeter 97
PM 2518 Multimeter, Digital Handheld . 129
PM 2525 Digital Multifunctional Multimeter • † 76
PM 2534 Multimeter, System • † 63, 313
PM 2535 Multimeter, System • † 63, 313
PM 2618 Multimeter, Digital Handheld . 129
PM 2718 Multimeter, Digital Handheld . 129
PM 2811 Programmable Power Supply • 315
PM 2812 Programmable Power Supply • 315
PM 2813 Programmable Power Supply • 315
PM 2831 Programmable Power Supply • 315
PM 2832 Programmable Power Supply • 315
PM 3050 Oscilloscope 60 MHz • 30
PM 3052 Oscilloscope 60 MHz, Rack Mountable • 32
PM 3055 Oscilloscope 60 MHz • 30
PM 3057 Oscilloscope 60 MHz, Rack Mountable • 32
PM 3065 Oscilloscope 100 MHz • 30
PM 3067 Oscilloscope 100 MHz, Rack Mountable • 32
PM 3070 Oscilloscope 100 MHz • 30
PM 3072 Oscilloscope 100 MHz, Rack Mountable • 32
PM 3082 Analog Oscilloscope 100 MHz • † 25
PM 3084 Analog Oscilloscope 100 MHz • † 25
PM 3092 Analog Oscilloscope 200 MHz • † 25
PM 3094 Analog Oscilloscope 200 MHz • † 25
PM 3208 Analog Oscilloscope 20 MHz 34
PM 3209 Analog Oscilloscope 40 MHz ... 34
PM 3335 CombiScope 20 MS/s Digital Storage • † 21
PM 3337 CombiScope 20 MS/s Digital Storage, Rack Mountable • † 23
PM 3350A CombiScope 100 MS/s Digital Storage • † 15
PM 3352A CombiScope 100 MS/s Digital Storage Rack Mountable • † .. 19
PM 3355 CombiScope 250 MS/s Digital Storage • † 15
PM 3357 CombiScope 250 MS/s Digital Storage Rack Mountable • † .. 19
PM 3365A CombiScope 100 MS/s Digital Storage • † 15
PM 3367A CombiScope 100 MS/s Digital Rack Mountable • † 19
PM 3375 CombiScope 250 MS/s Digital Storage • † 15

PM 3377 CombiScope 250 MS/s Digital Storage Rack Mountable • † .. 19
PM 3382 CombiScope 100 MHz • † 6
PM 3384 CombiScope 100 MHz • † 6
PM 3384E CombiScope with Automatic Time Base Mode † 13
PM 3392 CombiScope 200 MHz • † 6
PM 3394 CombiScope 200 MHz • † 6
PM 3580 Logic Analyzer 273
PM 3585 Logic Analyzer 273
PM 5109 Low Distortion LF Generator . 350
PM 5110 Low Distortion LF Generator . 349
PM 5132 Function Generator 347
PM 5133 Function Generator 345
PM 5134 Function Sweep Generator 342
PM 5135 Function Generator 340
PM 5138 Function Generator • 335
PM 5139 Function Generator • 335
PM 5150 Arbitrary Waveform Generator•† 321
PM 5190X Synthesized Function Generator • 333
PM 5191 Programmable Synthesized/ Function Generator • 326
PM 5192 Programmable Synthesized/ Function Generator • 326
PM 5193 Programmable Synthesized/ Function Generator • 326
PM 5330 Synthesized RF Generator 375
PM 5390 Programmable RF Generator 372
PM 5390S Programmable RF Generator 372
PM 5414V Color Pattern Generator PAL/NTSC 359
PM 5415 Color TV Pattern Generator PAL/NTSC 361
PM 5418 Color TV Pattern Generator SECAM/PAL/NTSC 361
PM 5418 TNSI Color TV Pattern Generator ... 370
PM 5418 TX Color TV Pattern Generator .. 370
PM 5705 10 MHz: 15V Output Pulse Generator 358
PM 5712 Pulse Generator, High Frequency TTL 357
PM 5715 Pulse Generator, High Frequency TTL 357
PM 5781 Pulse Generator • 351
PM 5786 2 ns Pulse Generator 355
PM 6303A* Automatic RCL Meter 98
PM 6304 Automatic RCL Meter 100
PM 6307 Wow & Flutter Meter 380
PM 6652C Programmable Universal Timer/Counter • 169
PM 6654C Timer/Counter • 169
PM 6662* Universal Frequency Counter • 187
PM 6665* Timer/Counter • 172
PM 6666* Timer/Counter • 172
PM 6669* Universal Frequency Counter • 187
PM 6671 Timer/Counter 120 MHz • 176
PM 6672 Timer/Counter 1 GHz • 176
PM 6673 120 MHz Reciprocal Frequency Counter • 183
PM 6674 550 MHz Reciprocal Frequency Counter • 183
PM 6675 600 MHz Reciprocal Frequency Counter • 183
PM 6676 1.5 GHz Reciprocal Frequency Counter • 183
PM 6677 2.3 GHz Reciprocal Frequency Counter • 183
PM 6680 Programmable Timer/ Counter • 159
PM 6681 Programmable Timer/ Counter• 165
PM 6685 Universal Frequency Counter•178
PM 8600 Logic Analyzer Pod/Cable 278
PM 8819 Series Logic Analyzer Clips and Leads 278
PM 8902 DC to AC Converter 44
PM 8903 Battery Pack, Charger, Inverter & Carrying Case 45
PM 8906 NiCad Battery Pack Charger ... 56
PM 8907 Line Voltage Adapter/ Battery Charger 56
PM 8911 Low Impedance Passive Probe 42
PM 8912 Low Impedance Passive Probe 42
PM 8914 CombiScope Interface Cable ... 47
PM 8917 Video Line Selector 43
PM 8918 Oscilloscope Probe Sets ... 41, 58
PM 8924 Modular 1:1 Probe 42
PM 8926 10:1 100 MHz Probe 41
PM 8929 10:1 400 MHz Probe 42
PM 8940 Isolation Amplifier 43
PM 8943A FET Probe 44
PM 8960 Rack Mount 46, 392
PM 8964 Rack Mount 46
PM 8969 Rack Mount 46, 392
PM 8989 Traveller Carry Cases 45
PM 8991 Oscilloscope Cart 46
PM 8992 Accessory Pouch 45
PM 9001 1:1 Probe 39, 60
PM 9002 Probe Accessory Set 43
PM 9003 Probe Accessory Set 43
PM 9010 10:1 100 MHz Probe 39
PM 9011 Switchable Probe 40
PM 9020 10:1 200 MHz Probe 39
PM 9021 Switchable Probe 40
PM 9051 Adapter BNC-Banana 382
PM 9053 Adapter BNC-Banana 382
PM 9061 Adapter BNC-BNC 382
PM 9067 T-piece BNC 383
PM 9071 Cable Banana-Banana 383
PM 9072 Cable, Banana-BNC 383
PM 9074 Cable, BNC-BNC 383
PM 9075 Cable, BNC-BNC 383
PM 9080 RS-232C Interface Adapter 59
PM 9081 Dual Banana Plug 58
PM 9082 Dual Banana Jack 59
PM 9083 ScopeMeter Protective Holster 56
PM 9084 Industrial Alligator Clips 58
PM 9085 Hook-Style Clip 58
PM 9086 NiCad Battery Pack 56
PM 9087 Automotive Lighter Plug Charging Adapter 56
PM 9090 Pin-Grabber Flexible Clip 58
PM 9091 50Ω Cable Sets 59
PM 9093 Mate BNC to Dual Female BNC Adapter 59
PM 9094 Accessory Set for ScopeMeter Probes 58
PM 9095 Single Banana Jack 59
PM 9100 100:1 200 MHz Probe 40
PM 9102 Probe Replacement Accessory Set 43
PM 9190 RS-232C Interface † 154
PM 9193 Analog Output Option 154
PM 9210 High Frequency Probe 152
PM 9212 Accessory Kit 152
PM 9218 Power Adapter 154
PM 9244 AC + DC Current Shunt 144
PM 9246 High Voltage Probe 153
PM 9249 Temperature Probe/PT100 147
PM 9264 Test Leads, 4-wire 140
PM 9265 Test Leads, Shielded 140
PM 9266 Sillicone Test Lead Set 59, 140
PM 9267 Data Hold Probe 153
PM 9278 Ever-Ready Case 150
PM 9280 Rack Mount 387, 392
PM 9355 AC Current Probe 44, 58
PM 9372 Modem Communicator Package 48, 60
PM 9381 Polaroid® Camera 46
PM 9541 Four-wire Test Cable 99
PM 9542 RCL Test Adapter 99
PM 9542 SMD SMD Adapter for PM 9542 .... 99, 102
PM 9546 Universal Chroma Unit 369
PM 9551 50Ω to 600Ω Adapter 382
PM 9553G Y/C+RGB Option 359, 368
PM 9560 Rack Mount Adapter 392
PM 9561 Rack Mount Unit ... 360, 369, 392
PM 9581 Feedthrough Termination (3W) 383
PM 9584 T-Piece, 50Ω 383
PM 9585 Feedthrough Termination (1W) 382
PM 9588 Coaxial Cable Set 383
PM 9591 10:1 50Ω Attenuator 46, 382
PM 9596 100:1 50Ω Attenuator 46, 382
PM 9598 10:1 75Ω Attenuator 46, 382

PM 9599 Set of 3 Attenuators 46, 382
PM 9604 GPIB Interface Option • . 175, 190
PM 9605 Battery Option 175, 190
PM 9607 MTCXO Time Base Option 175, 190
PM 9608 1.3 GHz Option 175, 190
PM 9609 Carrying Case 175, 190
PM 9610 1.5 GHz Option 171
PM 9611 Rear Panel Input Option 171
PM 9612 Fan Option 171
PM 9613 Rack Mount and Rack Slide Kit 392
PM 9623 Battery Unit 181
PM 9626 GPIB Interface 164, 181
PM 9629 TimeView Software 166
PM 9665B Low Pass Filter 382
PM 9666 Trigger Level Output Cable ... 171
PM 9669 Rack Mount Adapter 392
PM 9672 Carrying Case 177, 186
PM 9678B Time Base Oscillator (x-tal) Option 171, 177, 181, 186
PM 9690 Time Base Oscilllator (x-tal) Option 171, 177, 181, 186
PM 9691 Time Base Oscillator (x-tal) Option 171, 177. 181, 186
PM 9693 Battery Unit, Rechargeable 177, 186
PM 9694 BCD-Output/Display Offset Option 177
PM 9695 Analog Recorder Output (DAC) Option 171, 177, 186
PM 9696 IEC/IEEE-488 Bus Interface Option • 171, 177, 186
PM 9697 Ext. Ref. Frequency Multiplier Option .. 165, 171, 177, 181, 186
PV350 Digital Pressure/Vacuum Module 151
PV500 Digital Pressure/Vacuum Module 151
RPM 80 Inductive Pickup 154
RS40 RS-232C Terminal Cable 384
RS41 RS-232C Modem Cable 384
RS42 RS-232C Printer Cable 385
S45 QuickStart Software 69
S2290 LabTech Notebook Software . 212
TC100 Instrument Transport Cart 45, 203, 386
TL20* Test Lead Set 59, 139
TL22* Flexible Test Leads 137
TL24* Flexible Test Leads-Straight .. 138
TL26* 5-Way Multipoint Test Lead Set 139
TL28* 2-Way Clip Test Lead Set 140
TL70* Replacement Test Leads 138
TL75 Hard Point™ Test Lead Set 59, 138
TP20* Industrial Test Probes 138
TP80* Electronic Test Probes 138
Y900 Series Accessories 294
Y1702 RS-232C Null Modem 2m 384
Y1703 RS-232C Null Modem 4m 384
Y1705 RS-232C Null Modem 1 ft 384
Y1707 RS-232C 2m Cable 384
Y1708 RS-232C 10m Cable 384
Y1709 RS-232C 2m Printer Cable 47, 384
Y1790 5¼" Rack Adapter w/Slides 390
Y2044 8¾" Rack Adapter, with Slides 391
Y2045 8¾" Rack Adapter, without Slides 391
Y5003 Interface Cable 385
Y5004 Interface Cable 385
Y5020 AC or DC Current Shunt 245
Y5701 Interface Cable 228
Y5702 Interface Cable 228
Y5735 5¼" Rack Adapter with 24" Slides 391
Y5737 7" Rack Adapter with 24" Slides 391
Y7203 2-ft Ribbon Cable, PTI 385
Y7204 5-ft Ribbon Cable, PTI 385
Y8021 1m Cable for IEEE-488 Bus .. 383
Y8022 2m Cable for IEEE-488 Bus .. 383
Y8023 4m Cable for IEEE-488 Bus .. 383
Y8077 Four Terminal Short 74, 75
Y8100* DC/AC Current Probe .... 57 .... 140, 141
Y8101* AC Current Probe 140, 141
Y8131* Test Leads 139
Y8132* Test Leads (Shrouded) 139
Y8133* Test Lead Set 139
Y8134* Test Leads (Shrouded) 139
Y8140* Slim Test Leads 140
Y8205* Soft Carrying Case 149
Y8598 3½" Rack Adapter with Slides 390
Y8599 3½" Rack Adapter 390
Y8834 Offset Rack Mount Kit 389
Y8835 Dual Rack Mount Kit 389
Y8836 Center Rack Mount Kit 389
Y9108* BNC Jack to Double Banana 154
Y9109* Binding Post to BNC Plug 154
Y9115* Phone Plug to BNC Jack 382
Y9117* Phono Jack to BNC Plug 382
Y9308 Type N-to-BNC 50Ω Adapter 382
Y9315 Type N Coaxial Cable 404
Y9316 Non-Shortening BNC Cap 403
Y9317 Type N 50Ω Termination 403

* Distributor stock item
• IEEE-488
† RS-232C

Oscilloscopes

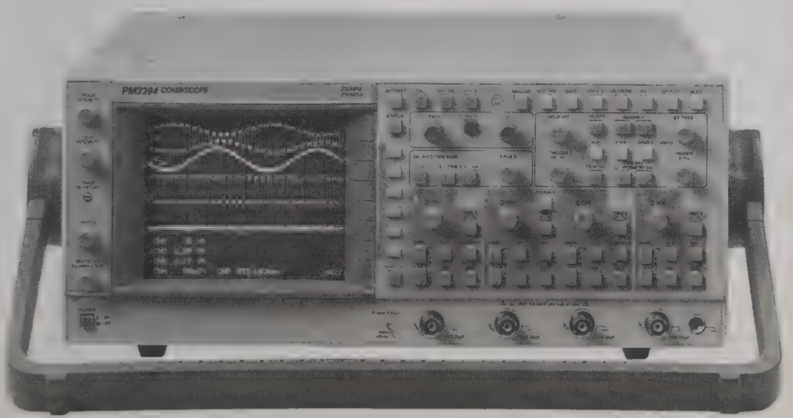


PM 3094 Page 25

Digital

Analog

For a detailed discussion on the merits of Analog and Digital display techniques, see page 3



PM 3394 Page 6

The range of oscilloscopes detailed in this section of this catalog addresses many of the measurement and signal viewing needs in R&D, Production, Service and Training applications.

The range includes 8 analog models with bandwidths of up to 200 MHz including the world's only full four channel monolithic analog scopes. Almost all analog oscilloscopes can be equipped with IEEE-488 interface for remote control.

There is a choice of 9 CombiScope™ models in this catalog, offering the best of both worlds: Analog performance, ease of use and familiarity combined with powerful Digital Storage Oscilloscope performance in one cabinet. On these models, one push button switches between the Analog and Digital storage mode and back.

Most of these CombiScopes are available with IEEE-488 interface, RS-232 interface, or both.

Most Fluke oscilloscopes in this catalog include AUTOSET. This function selects the proper channel and trigger conditions, sets the proper amplitude, and selects a time base speed to match the signal under test. In some of the models introduced in this catalog, AUTOSET is even controlled from the probe!

Selection Guide	Page 2
Introduction	Page 3
CombiScopes	Page 6
Analog Oscilloscopes	Page 25
Oscilloscope Accessories	Page 36
Oscilloscopes Software	Page 47

CombiScope™ Selection Guide

Model	Bandwidth (Rise Time)	Acceleration Voltage	Sample Rate	Max Stored Frequency	Acquisition Memory	Ref Memory (Waveforms)	Vertical Resolution	Channels	Waveforms On Screen	Cursors/ MATH	GPIB/ RS-232	Page
PM 3394	200 MHz (1.75 ns)	16.5 kV	200 MS/s	200 MHz	8K 32K Option	3 x 8K 3 x 32K Option	8-bit	4	8	Yes Option	Option Standard	6
PM 3392	200 MHz (1.75 ns)	16.5 kV	200 MS/s	200 MHz	8K 32K Option	3 x 8K 3 x 32K Option	8-bit	2 + 2	8	Yes Option	Option Standard	6
PM 3384	100 MHz (3.5 ns)	16.5 kV	200 MS/s	100 MHz	8K 32K Option	3 x 8K 3 x 32K Option	8-bit	4	8	Yes Option	Option Standard	6
PM 3382	100 MHz (3.5 ns)	16.5 kV	200 MS/s	100 MHz	8K 32K Option	3 x 8K 3 x 32K Option	8-bit	2 + 2	8	Yes Option	Option Standard	6
PM 3375	100 MHz (3.5 ns)	16 kV	250 MS/s	100 MHz	4K	12K	8-bit	2	4	Yes	Option	15
PM 3365A	100 MHz (3.5 ns)	16 kV	100 MS/s	100 MHz	4K	12K	8-bit	2	4	Yes	Option	15
PM 3355	60 MHz (5.8 ns)	16 kV	250 MS/s	25 MHz	4K	12K	8-bit	2	4	Yes	Option	15
PM 3350A	60 MHz (5.8 ns)	16 kV	100 MS/s	10 MHz	4K	12K	8-bit	2	4	Yes	Option	15
PM 3335	60 MHz (5.8 ns)	16 kV	20 MS/s	2 MHz	8K	8K	8-bit	2	4	Yes	Option	21

Analog Oscilloscope Selection Guide

Model	Bandwidth (Rise Time)	Time Base	Trigger Bandwidth	Acceleration Voltage	Channels	Dual Time Base	Cursors	GPIB/ RS-232	Autoset	Page
PM 3094	200 MHz (1.75 ns)	2 ns/div	300 MHz	16.5 kV	4	Yes	Yes	Option Standard	Yes	25
PM 3092	200 MHz (1.75 ns)	2 ns/div	300 MHz	16.5 kV	2 + 2	Yes	Yes	Option Standard	Yes	25
PM 3084	100 MHz (3.5 ns)	5 ns/div	200 MHz	16.5 kV	4	Yes	Yes	Option Standard	Yes	25
PM 3082	100 MHz (3.5 ns)	5 ns/div	200 MHz	16.5 kV	2 + 2	Yes	Yes	Option Standard	Yes	25
PM 3070	100 MHz (3.5 ns)	5 ns/div	150 MHz	16 kV	2 + 1	Yes	Yes	Yes (Option)	Yes	30
PM 3065	100 MHz (3.5 ns)	5 ns/div	150 MHz	16 kV	2 + 1	Yes	No	Yes (Option)	Yes	30
PM 3055	60 MHz (5.8 ns)	5 ns/div	100 MHz	16 kV	2 + 1	Yes	No	Yes (Option)	Yes	30
PM 3050	60 MHz (5.8 ns)	5 ns/div	100 MHz	16 kV	2	No	No	Yes (Option)	Yes	30
PM 3209	40 MHz (8.8 ns)	20 ns/div	40 MHz	12.5 kV	2	Yes	No	No	No	34
PM 3208	20 MHz (17.5 ns)	20 ns/div	20 MHz	2 kV	2	No	No	No	No	34

Oscilloscopes are available from a wide variety of sources and manufacturers. During the last few years, many oscilloscope manufacturers and specifiers have contributed to a transition from the traditional and trusted direct view Analog Oscilloscope to the more powerful, but also more complex, Digital Storage Oscilloscope (DSO). Many applications will benefit from this transition, but not all. The reason for this is the fact that not all signals take kindly to the process of sampling, digitizing, and storing the analog information present in the signals under test. It is for this reason, that Fluke is committed to offering the best value in the best of both worlds: Oscilloscopes combining the functions of powerful digital storage oscilloscopes and complete analog instruments in one case. This catalog describes one of the widest choices of such CombiScopes™ available from any manufacturer. This range starts with the 60 MHz, 20 MS/s PM 3335, up to the 4 channel, 200 MHz, 200 MS/s PM 3394. There are a total of nine models of CombiScopes to choose from!

In addition, this catalog includes a full line of easy to use analog oscilloscopes with bandwidths of up to 200 MHz in the powerful, four channel, PM 3094.

Analog, Digital or Both?

Although digital oscilloscopes marked a significant breakthrough in signal monitoring, many situations still call for analog oscilloscopes. Pure digital storage or pure analog scopes provide only part of the answer when dealing with complex signals or more thorough waveform analysis. Combination analog/digital oscilloscopes known as CombiScopes are the obvious single scope solution.

They also facilitate the introduction of digital technology to what was formerly a purely analog world. Many users simply feel more comfortable with the familiarity and ease-of-use associated with analog systems. Both analog and digital have their advantages; the real time capabilities of analog cannot be matched by digital scopes, yet digital scopes are unrivalled for pre-trigger viewing and providing consistent high-brightness for fast sweeps and single shot or low repetition rate signals.

This introduction discusses the merits of combined analog and digital capabilities in a CombiScope, making a comparative study of how several different types of signals are handled in both analog and digital modes. With the exception of figure 4, the screen photographs are taken from the PM 3394 family of CombiScopes.

Reproducing Simple Repetitive Signals

Figure 1 shows the analog trace of a fast rising edge. Figure 2 shows the same signal, on the same CombiScope, but using digital storage mode. There is little difference between the two, and both signals can be easily measured. At first glance, the choice between analog and digital modes does not seem crucial.

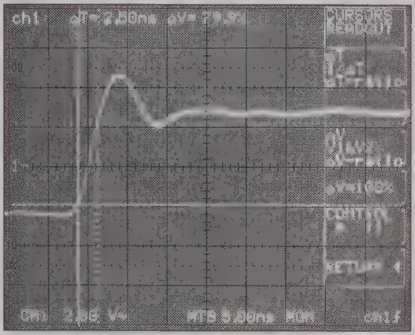


Fig. 1. Analog trace of a fast rising edge.

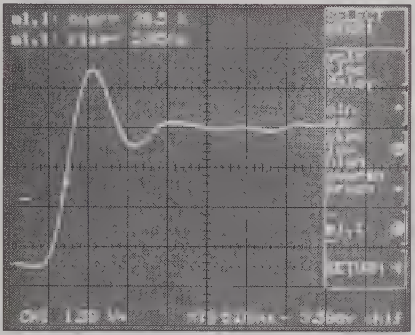


Fig. 2. The same rising edge when viewed in digital storage mode.

The digital trace, however, is constructed using repetitive sampling, a process deployed by almost all digital storage oscilloscopes to monitor fast signals of this type. This entails building up the trace over repeated occurrences of the waveform, with each progressive acquisition used to modify the previous trace. Consequently, if the signal changes, it can take several seconds before a sufficient number of samples have been taken to reconstruct the waveform. This creates a time lag between user adjustment and the new signal appearing on screen.

The analog display, on the other hand, is real time. If the signal changes, the display responds instantly. Therefore, for frequently changing signals, analog mode of the CombiScope is more suitable.

Analyzing Composite Video Signals

The composite video signal is an example of a complex modulated analog signal. When viewed in analog mode, the intensity of the various signal elements provides a great deal of information to the trained eye concerning the nature of the waveform and therefore the performance of the system. Figure 3 shows a composite video signal as an analog trace. The color modulation can be clearly seen, and the time distribution of the waveform is also evident.

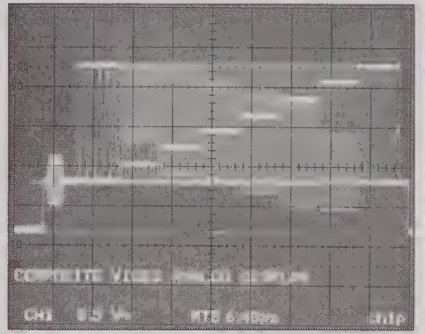


Fig. 3. Composite video signal using analog mode.

Given the complexity of the signal, sampling and digital reconstruction do not produce a display with nearly the same amount of information as analog mode. This is demonstrated in figure 4, a typical raster scan CRT display of the same waveform on a digital only oscilloscope. Even though certain digital scopes have two or more intensity levels, limitations of screen resolution and of the intensity itself means an analog signal display is still preferable.

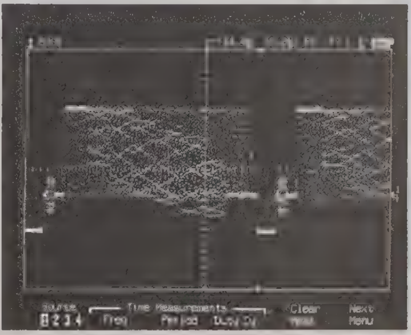


Fig. 4. Stored composite video signal as reproduced on a purely digital scope.

To analyze specific parts of the waveform, however, digital reconstruction can be advantageous. The color burst in the video signal has a frequency of several MHz and at the same time has a relatively low repetition rate, especially when viewing a single selected line. This is not a problem for digital scopes, which display the waveform with a uniform intensity. Figure 5 shows the color burst of a single line of a video signal, as displayed in digital storage mode. Analog scopes can encounter intensity problems in reproducing such signals, as the signal is not present long enough to give high brightness on the CRT.

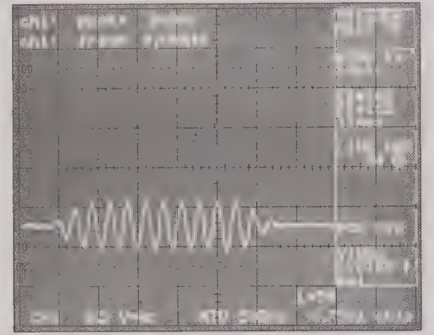


Fig. 5. Color burst on a line of a video signal, using digital storage mode.

Locating Glitches Using Digital Peak Detection

When viewing a complete waveform in analog mode, short duration spikes or "glitches" are impossible to see. This is demonstrated in figure 6, which shows a staircase waveform that has glitches deliberately added.

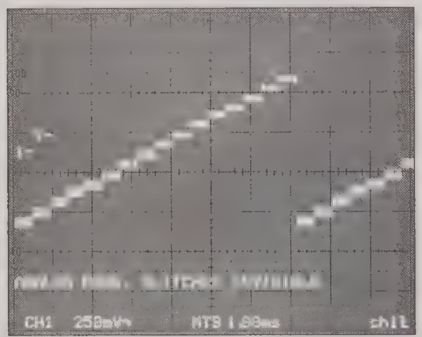


Fig. 6. Repetitive staircase signal with added glitches viewed in analog mode, with the glitches invisible.

Digital mode has a facility known as peak detection, which detects and displays such glitches. The result can be seen in figure 7, a digital representation of the same waveform as was used in figure 6.

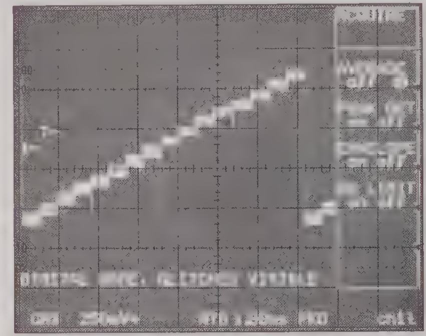


Fig. 7. The same staircase signal when viewed in digital storage mode, with visible glitches.

When an oscilloscope has dual time base facilities, such waveforms can be analyzed in great detail. Figure 8 is an example of this, using intelligent triggering to clearly show the 165 nanosecond spikes.

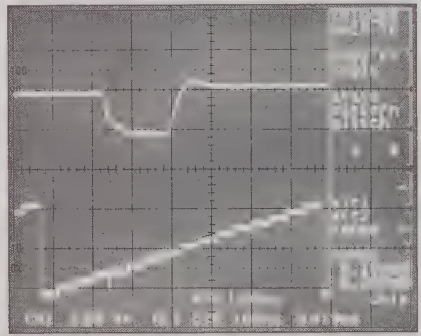


Fig. 8. Dual time base display of the staircase signal, in digital storage mode.

The advent of digital technology has made it possible to view signals that were previously difficult to monitor due to cost and logistical constraints. Often UV recorders, digitizers, tube storage scopes, cameras and long persistence tubes were necessary. Furthermore, events that happen only once can not normally be registered on an analog scope. Using the digital facilities on a CombiScope™, these unique events can be digitized, stored for recall, and subsequently analyzed by computer or fed to a hard copy device.

Multi-Channel Capabilities

This capability can be extended to more than one channel. A number of four channel digital storage oscilloscopes can trigger on a pattern or a combination of logic states at the inputs. This has obvious attractions to hardware engineers.

Digital storage scopes are designed so the trigger stops data acquisition. If the trigger point is set in the middle of the memory, the signal preceding the trigger point is also stored. This is beyond the capabilities of an analog scope, which at best can display a few nanoseconds on higher bandwidth models with delay lines - and even then only by using photography for single shots.

Pre-trigger information can often be of great importance. In figure 9 the transient voltage caused by tapping a standard BNC connector on a bench is shown. The trigger point is level with the "T" on the first large positive going edge. Using digital storage shows clearly that the first major peak in the transient was negative.

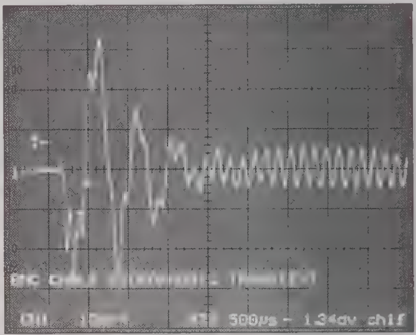


Fig. 9. Digital trace of a transient voltage in a BNC connector, with trigger point and pre-trigger waveform shown.

Waveform Analysis Using CombiScope

Once the optimum mode has been selected to display the waveform, CombiScopes can be used to extract a tremendous amount of information. Analog waveforms can be measured for voltage and time changes using cursors. Automatic determination of peak-peak voltages and rise and fall times is possible. In digital mode the waveform is stored in binary code, and can therefore be processed like computer data. Frequency, Vrms, period, rise time, overshoot and pulse width can all be ascertained simply. Filtering of stored waveforms can reveal hidden signals, and Fast Fourier Transforms (FFT) yield the frequency components of a signal. This is shown in figure 10, a FFT as seen in digital mode, with results in both Hertz and decibels.

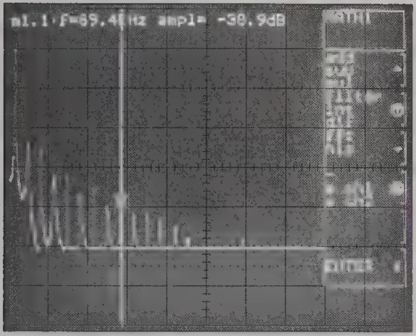


Fig. 10. A Fast Fourier Transform shown using digital mode in Hertz and decibels.

Any stored data can be transferred to a PC for further analysis or storage. It can also be sent to a printer or plotter, and the hard copy also shows the graticule and any on-screen measurement results.

Digital storage oscilloscopes can carry out automatic pass/fail testing. The trace to be tested can be compared either with a user-specified reference template, or against pre-defined measurement limits. When a fail situation occurs, the digital storage oscilloscopes is capable of taking several pre-selected actions. A hard copy can be generated for analysis, the trace can be stored in memory for future reference, an alarm can be activated, or the process can be stopped. This is illustrated in figure 11.

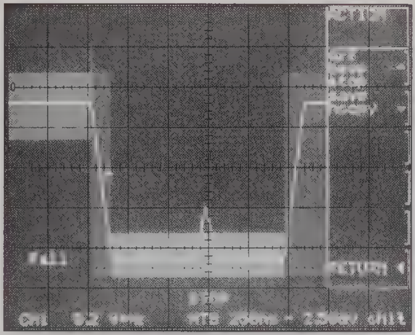


Fig. 11. Signal with reference template and pre-selected options for action in fail situations.

Figure 12 shows how reference templates can be created on screen using cursor controls. Frequently used templates can be stored in non-volatile reference memory, and are thus protected against erasure due to supply failure. Templates can also be downloaded from a computer via RS-232 or IEEE-488.2 interfaces.

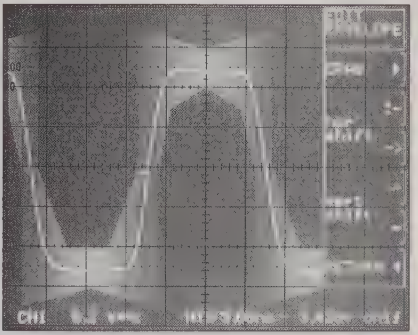


Fig. 12. Creating reference templates using cursor controls.

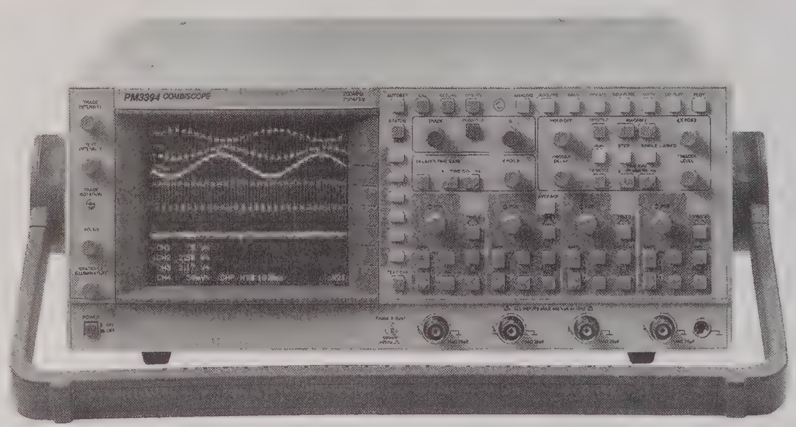
Best of Both Worlds

It can be concluded that for every day use, engineers require both analog and digital storage oscilloscopes for optimum viewing and analysis of signals. Although both systems have their relative merits, neither is all-encompassing enough to be used in isolation. Modern CombiScopes™ give the best of both worlds in one instrument.

PM 3382, PM 3384, PM 3392 & PM 3394

SCPI
GPIB
IEEE-488

RS-232



PM 3394

PM 3382/84 100 MHz & PM 3392/94 200 MHz CombiScopes
Combined analog and digital oscilloscope performance in one instrument
Up to 200 MS/s sample rate
100 or 200 MHz analog and digital bandwidth
True 4 channel operation
Extensive TV and logic triggering
Up to 32K acquisition memory for storage of more than 200 traces
Real time Digital Signal Processing (DSP)
Extensive mathematical functions
GPIB/IEEE-488.2 (SCPI) interface capability

CombiScope: The Best of Both Worlds

The oscilloscopes described on the following pages are CombiScopes™. This means each instrument combines a high performance Digital Storage Oscilloscope (DSO) with a fully featured analog oscilloscope. At the touch of a button, the operation changes from analog display to Digital Storage Oscilloscope operation and back. Better said: these are DSOs with an analog button. Why?

Because some users can't rely solely on the capabilities of a pure DSO. Furthermore, some signals do not take kindly to being digitized. Examples include simple AM signals, complex data streams and video signals.

If you don't see what you expect, or don't trust what you see, just touch the button to switch operating mode.

Delayed time base is available in either mode of operation. In addition, the digital mode offers pre-trigger recording as well as delay by events. All delay functions can be combined to make some of the most powerful acquisition capablities.

For a full discussion on the topic of "Analog, Digital, or Both?", see the introduction in the oscilloscope section of this catalog.

Up to 4 Channels - Up to 200 MHz

This family of CombiScopes consists of four models matching the performance you need, within the available budget:

- PM 3394 200 MHz Four Channels
- PM 3392 200 MHz Two + two Channels
- PM 3384 100 MHz Four Channels
- PM 3382 100 MHz Two + two Channels

Each of these instruments can be further enhanced by a choice of up to three options:

- **MathPlus:** Offering extensive signal analysis features that include Integration, Differentiation and FFT. This option also includes limit testing capabilities for ATE applications, as well as multiple single shot recording of up to 200 traces in memory.
- **Extended Memory:** Offering user partitioned memory allocation to permit storage of up to 32K long records, or up to 200 traces of 512 points.
- **IEEE-448 - SCPI:** Full control of all of the oscilloscope functions, and full waveform transfers with a SCPI compatible GPIB/IEEE-488* option. (RS-232 is always included)

Operation of Digital Storage That is as Easy as if it Were Analog

With oscilloscopes this powerful, easy access to all functions is of paramount importance. These CombiScopes have been designed with the controls and layout so that the most frequently used functions have their own control or button giving instant direct access. Layout is logical, and all functions that work in the Analog mode work in the same way in the Digital mode. A dedicated processor continuously scans the controls and buttons, so that the operation of these models is as fast as if they were fully analog. Additional functions are in logical and easy to understand, "shallow" menus.

Triggering to Deal With the Impossible

Trigger features include full triggering for either time base, in either operating mode. In the digital mode, logic state and logic pattern triggering allow you to set qualified trigger conditions using all of the four input channels. Glitch triggering allows for time qualified trigger conditions starting from 10 ms to a fast 2 ns. Using time qualification for the beginning of a block of data.

Choice of Memory

These CombiScopes come with 8K of waveform memory. The extended memory option extends it to 32K. Memory is easily partitioned by the user giving the optimum between record length, number of traces stored, and update speed (shorter records provide shorter update speed). With standard memory, the choice can be from one 8K record to 36 records of 512 points. The Extended Memory option allows for one 32K record, to over 200 records of 512 points each. Regardless of the record length selected, the user can always display the full contents of the memory.

Cursors and Measurements

Cursors are available in both Analog and Digital modes. In the DSO mode, the cursors are supplemented by automatically calculated measurements that include: Vp-p, Vrms, Vmax and Vmin, frequency and period, rise time and overshoot. "Touch-Hold and Measure™" gives you instant measurement results. It provides a quick update of Vdc, Vp-p, Vrms and Frequency at the touch of a button located on the probe itself.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Signal Analysis

The traditional way to look at an oscilloscope display is when amplitude is displayed as a function of time. You can do that, too. These CombiScopes offer a very extensive set of signal analysis functions that include Addition, Subtraction, and Multiplication of signals. Digital Filtering permits noise or high frequency components to be removed from signals, including single events. With the MathPlus option installed, waveforms can be Differentiated to find Slew rate, Integrated for Area under the curve, and an FFT is included to find frequency components of any signal. The fast Digital Signal Processor (DSP) presents the results in almost real time.

Supports Test Engineering and Factory Automation

The MathPlus option includes a variety of features to support factory automation. Measurement results can be updated, with statistical records of the highest and lowest values kept in memory. Measurement data can be used to perform automatic Pass/Fail tests. In addition, Pass/Fail tests can be performed on the actual waveform itself, by comparing it with a template stored in memory. You can create such templates in the scope itself, or download it from a PC.

Field Service Support

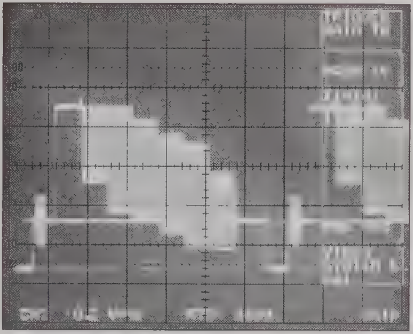
With heavyweight performance weighing in at approximately 20 pounds, and with their rugged construction, these scopes are built to go. A full analog scope and a full Digital Storage Oscilloscope in one cabinet, means you don't have to compromise. And they are easy to use! Modem support software is available, enabling service personnel to upload and download waveforms, instrument settings, and measurements from and to any DOS based PC.

Hard Copy

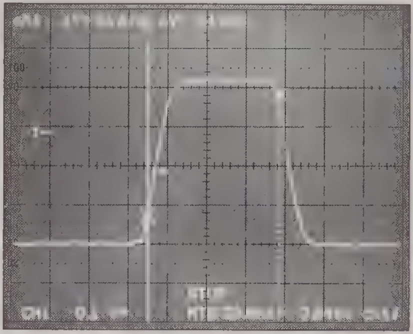
These scopes support 9 pin and 24 pin dot-matrix printers. LaserJets (HP PCL 4 and PCL 5) are also supported. Plotter support is also provided for a selection of HP (compatible) plotters, as well as a generic HPGL driver. The HPGL driver is also useful to provide output to PCs, so that HPGL files can be directly imported in most popular word processing packages to provide professional documentation with ease.

Built to Last, at Low Cost

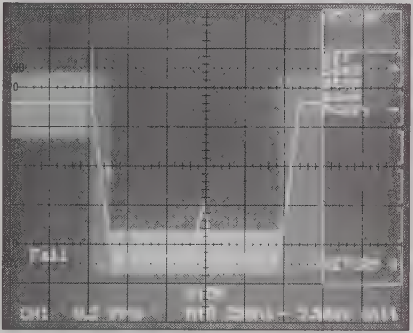
Hi tech design eliminating trimmers and pots mean no internal adjustments. Calibration is done "closed case". Calibration is METCAL supported and completed in less then one hour. With all of the controls being µP operated, and all of the switching being done in sealed environments, controls are impervious to dust, moisture, or wear. A calculated MTBF of over 15,000 hours, a three year warranty, and a five year warranty on the CRT, these scopes will perform reliably and at low cost to the owner for many years to come.



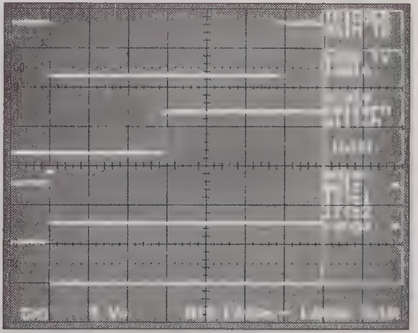
Monitoring video signals and other modulated or complex signals requires the infinite resolution and intensity variation only available from a true analog scope.



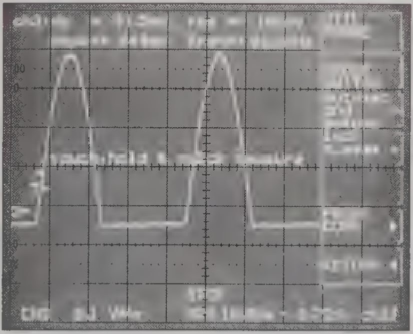
The pre-trigger capability of a DSO shows what leads up to an event, as well as the leading edge of signals – even if they only occur once.



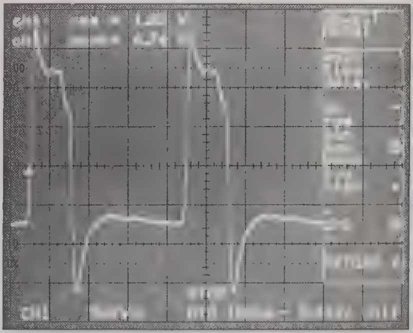
Pass/fail function showing a glitch that violates the reference envelope or template, causing a fail event.



Pattern triggering is useful in microprocessor and logic applications, and in mixed analog/digital circuits.

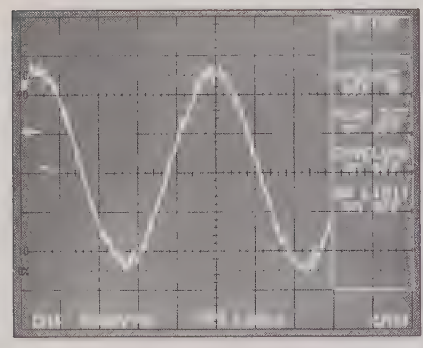


The probe-operated Touch Hold and Measure™ feature freezes the trace on-screen, and displays measured results.

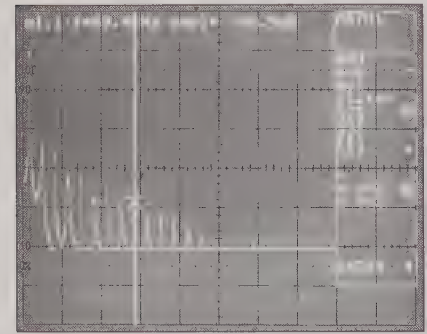


These CombiScopes feature an extensive set of built-in calculated voltage and timing measurement functions. Instant results can be obtained two ways: By simply selecting the desired measurement function and the channel on the front panel. Or using the probe-mounted Touch Hold and Measure button.

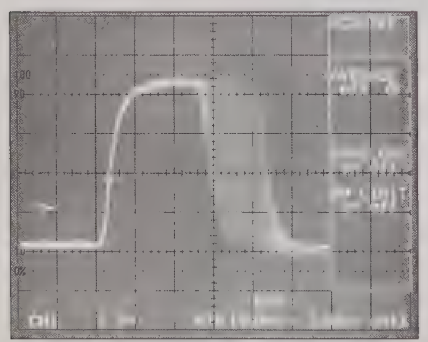
PM 3382, PM 3384, PM 3392 & PM 3394



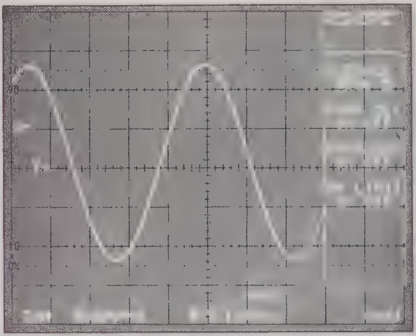
To suppress noise on repetitive signals the averaging mode smooths the representation of the trace. For non-repetitive signals, digital filtering is provided to suppress noise.



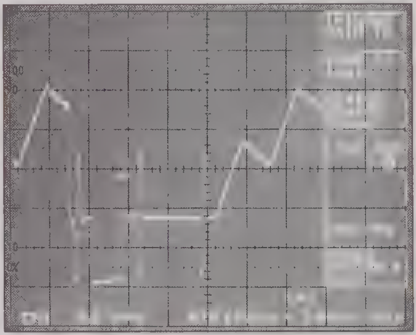
Waveform analysis functions provide flexibility, and allow you to probe deeper into your waveform to reveal hidden data and relationships. Here FFT analysis shows results in Hz and dB.



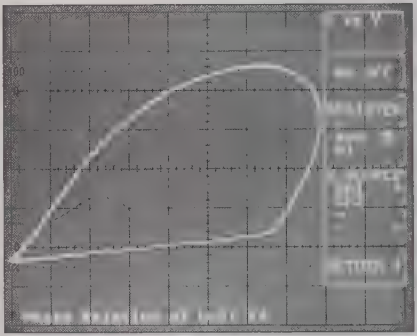
The envelope mode monitors signal variations over time. You can measure interference signals jitter, amplitude modulated signals and more.



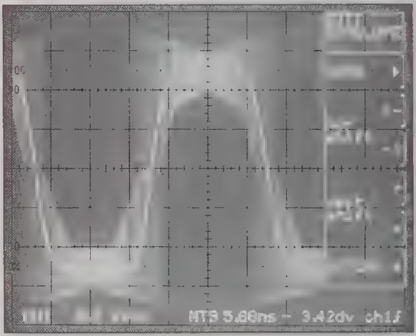
Both averaging and low-pass filtering improves vertical resolution. Results are stored in 16-bit memory.



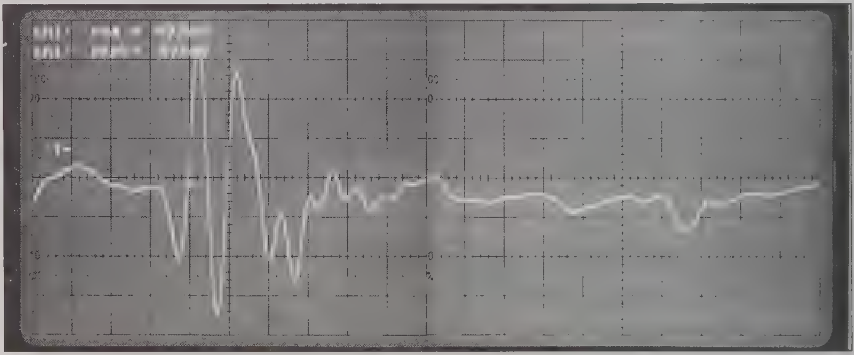
For high resolution video application HDTV tri-level-sync triggering is included. The scopes also include a digital line selector. Delay and magnification or a fully triggered delayed time base can be used to expand any part of a selected line or any other part of a signal.



The X versus Y mode lets you display any of the four channels against another. This XY mode is extremely useful for modulation, voltage/current curves, and mechanical signals phase displays.



Reference templates for pass/fail testing can be created in seconds on screen simply by using cursor controls. That way, you can create your own reference envelope, for example, by recreating a CCITT reference template for PCM testing. Frequently used reference templates can be stored in the reference memories and protected. Templates can also be downloaded from an external computer.



Multiple single shot features total memory which you can use to automatically store up to 32 consecutive traces (512 samples each) to capture multiple single shots. With the memory extension included, over 200 traces can be stored.

PM 3382, PM 3384, PM 3392 & PM 3394

Specifications

Technical Specifications

CombiScopes

Analog and Digital: These CombiScopes are analog/digital combination scopes with screen readout, cursors and a fully triggered delayed timebase. With a single push on a button one can switch between the familiar analog mode with a real time signal display and the digital mode. In the digital mode all typical DSO benefits are available: trace storage, pre trigger view, calculated measurements, hardcopy facilities, advanced trigger modes, averaging and FFT. The probe operated Touch Hold and Measure™ freezes the display and instantly displays measured signal parameters : Vdc, Vrms, Vp-p and frequency.
Display: 8 X 10 cm viewing area, 16.5 kV acceleration voltage. Parallax free graticule with continuously variable illumination. On screen settings readout.
AUTOSET: Selects proper channel-, timebase- and trigger settings. Function can be customized by the user.
AUTOCAL: Automatic fine adjustment for enhanced accuracy to get optimum performance even under extreme environmental conditions.
Automatic Testing: The additional pass/fail testing offered by the MATH+ option in combination with the GPIB/IEEE488.2 interface make these scopes a powerful fully programmable tool in automatic test applications.
Memory: The record length is optionally expandable to 32K samples per trace and up to 204 traces in memory (at 512 samples/trace).

Analog Mode

Vertical Deflection

Input Channels: Four channels with full attenuator range on each channel or Four channels in a 2+2 configuration (PM 3392 / PM 3382). On screen channel identifiers with ground level indication.
Display Modes: CH1, +/-CH2, CH3, +/-CH4, Add, Subtract.
Bandwidth: >200 MHz -3 dB or >100 MHz -3 dB (PM 3384 / PM 3382)
Bandwidth Limiter: 20 MHz -3 dB
Rise Time: <1.75 ns (calculated : 0.35/BW) or <3.50 ns (PM 3384 / PM 3382)
Deflection Coefficient: 2 mV/div to 5 V/div in a 1-2-5 sequence or calibrated vernier control: 2 mV/div to 12.5 V/div.
Channel: 3 and 4 0.1 V/div and 0.5 V/div (PM 3392/PM 3382)
Error Limit: 1.3% (measured over center 6 divisions)
Input Impedance: 1 MΩ ±1% // 25 pF ±2 pF and 50Ω ±1% (PM 3394 and CH1 & 2 of PM 3392)
Maximum Rated Input Voltage: In 1 MΩ position: 400V (dc + ac peak; <10 kHz). In 50Ω position: 5V rms; 50V ac-peak (maximum of 50 mJ during any 100 ms interval).
Dynamic Range: 24 div at 50 MHz
CMRR: 100: 1 at 1 MHz, 25: 1 at 50 MHz
Channel Isolation: 50: 1 at full bandwidth (100 or 200 MHz)

Horizontal (Main and Delayed Time Base)

Display Modes: Main time base, Delayed time base, Alternate time base (Main and Delayed time base), X-Y mode.
Time Coefficients: 0.5 s/div to 20 ns/div in a 1-2-5 sequence or calibrated vernier control: 1.25 s/div to 20 ns/div. For PM 3384 and PM 3382 the fastest time base setting is 50 ns/div.
Fastest Sweep: 2 ns/div (magn 10x) or 5 ns/div (PM 3384 / PM 3382)
Error Limit: (magn 1x) ±(1.3% of reading + 0.5% of 8 divisions)

Delay Time Multiplier

Resolution: 1:40,000
Error Limit: (magn 1x) ±(0.8% of reading + 0.3% of 8 divisions + 4 ns)
Jitter: 1:25,000

Triggering (Main and Delayed Time Base)

Trigger Modes: Auto free run, Triggered, Single; Edge triggering, TV triggering.

Edge Triggering

Main TB Trigger Source: CH1 to CH4, Line
Delayed TB Trigger Source: Starts after delay or triggered on: CH1 to CH4
Slope: Positive (+) or negative (-)
Coupling: DC, AC (10 Hz), LF-rej (30 kHz), HF-rej (30 kHz).
Trigger Gap: 0.4 div (or 0.8 div for triggering on noisy signals)
Level Range: ±8 div or automatic level within signal peak-peak range
Level Indication: On screen level indicators and numeric readout

Trigger Sensitivity
PM 3394/PM 3392: 0.6 div up to 100 MHz, 1.2 div up to 200 MHz, 2 div up to 300 MHz
PM 3384/PM 3382: 0.6 div up to 50 MHz, 1.2 div up to 100 MHz, 2 div up to 200 MHz

Video Triggering

Video Standard: HDTV, NTSC, PAL, SECAM
Main TB Trigger Source: CH1 to CH4; Field 1, Field 2, lines , by line selector selected line
Delayed TB Trigger Source: Starts after delay or triggered on: CH1 to CH4 edge, TV-line; the Delayed time base can be used to expand any part of the line selected with the TV-line selector.
Signal Polarity: Positive or negative
Sensitivity: 0.7 div (sync. pulse)

X-Y Mode

X-deflection Source: CH1 to CH4, Line
X-deflection Coefficient: Same as for vertical deflection
Dynamic Range: 20 div up to 100 kHz; >10 div up to 2 MHz
Frequency Response: 2 MHz -3 dB
Error Limit: 5% measured over central 6 divisions
Phase Shift: <3° up to 100 kHz

Cursor Measurements

Cursor Modes: Horizontal, Vertical, Both
Readout: Vertical: dV, V1&V2 to GND, Ratio
Horizontal: dT, 1/dT (in Hz), Ratio, Phase
Accuracy: (magn x1) 1% of full scale. Within the central 8 horizontal and 6 vertical divisions.

Digital Mode

Acquisition

Sample Rate: Real time sampling up to: 200 MS/s (single channel), 100 MS/s (dual channel). A fast chopper offers 200 ns horizontal resolution in 4 channel single shot mode.
Random Sampling: Random sampling for repetitive signal display (4 CH) up to the full 200 MHz bandwidth (100 MHz for PM 3384/PM 3382)
Bandwidth: 200 MHz (Recurrent and single shot), 100 MHz for PM 3384/PM 3382
Maximum Captured Frequency:
Calculated maximum captured frequency in single shot mode:
- For 10 samples per period linear interpolated: 20 MHz in 1 CH mode, 10 MHz in 2 CH mode, 0.5 MHz in 4 CH mode
- Using sine interpolation to reconstruct signals using 5 samples per period: 40 MHz in 1 CH mode, 20 MHz in 2 CH mode, 1 MHz in 4 CH mode.

ADC Resolution: 8 bit
Memory: 16 bit wide; acquisition and reference memory can be segmented offering choice between long acquisition records or a maximum number of traces in memory
Record Length: 8K (single channel),4K (dual channel), 2K (four channels) or 512 samples (to allow a maximum number of traces stored in reference memory)
Memory Size: Acquisition and reference memory allow total storage of: 3 traces of 8K samples, 6 traces of 4K samples, 12 traces of 2K samples or 40 traces of 512 samples
Memory + Option: Maximum record length expanded to 32K; traces in memory: 3 traces of 32K, 6 traces of 16K, 12 traces of 8K, 204 traces of 512 samples each
Average: Factor: 2,4,8 to 4096; maximum resolution: 16 bit
Peak Detection: Captures glitches up to 5 ns (single channel), 10 ns (dual channel) or 10 ns (4 channel alternating)
Envelope Mode: For continuous tracking of changing waveforms

PM 3382, PM 3384, PM 3392 & PM 3394

Vertical

Bandwidth: >200 MHz -3 dB or >100 MHz -3 dB (PM 3384/PM 3382)

Magnification: Up to 32x magnification for higher deflection sensitivity; up to 4096x averaging for maximum resolution (maximum 16 bit)

Display Modes: CH1, +/-CH2, CH3, +/-CH4, Calculated Add and Subtract

Bandwidth Limiter: 20 MHz -3 dB

Window Mode: 2 or 4 windows to display two or four traces above each other while using the full dynamic range of the ADC (8 bit)

Horizontal

Acquisition Modes: Recurrent (Auto and Triggered), Single shot, Multiple single shot (included in MATH+ option), Roll, Triggered Roll

X-Y Mode: Any trace in memory or any of the four channels can be used as X source

Time Base Modes: Main TB, Delayed TB, Alternate TB (Main TB and Delayed TB). Delayed time base starts after delay or triggered on channel.

Trigger Coupling: Same as for analog mode

Time Base: Real time sampling: 200 s/div to 500 ns/div, 250 ns/div (magn x1)

Recurrent: 200 ns/div to 2 ns/div (5 ns/div for PM 3382/PM 3384)

Roll Mode: 200 s/div to 50 ms/div, triggered or free roll mode

Display Resolution: Horizontal resolution for 1x magnification: 500 samples = 10 divisions = 1 screen width. Magnification 1/2, 1/4, to .. allows a compact full information display of a full record (8K or 32K).

Magnification: 2x,4x to 32x

Interpolation: Dots only display or Sine or Linear interpolated display; sine interpolation offers natural signal representation of expanded single shot acquisitions up to 10 ns/div

Triggering

Edge Triggering: Same as for analog mode

TV Triggering: Same as for analog mode (including digital TV-line selector)

Logic Trigger Modes: State (4 bit), Pattern (4 bit), Glitch (time qualified pulse)

Sensitivity: 1 div (if time present >= 10 ns; 20 ns for PM 3382 and PM 3384), 2 div (if time present >= 2 ns; 4 ns for PM 3382 and PM 3384)

State Triggering: Max. clock rate: 150 MHz. Any of the four channels can be selected as clock.

Pattern Triggering: Mode: Enter, Exit, Time qualified (lower limit, upper limit, range)

Range of Limits for Pattern Triggering: 20 ns to 166 ms; resolution: 10 ns; minimum time for pattern to be present is 2 ns (4 ns for PM 3382 and PM 3384)

Glitch Triggering: Minimum glitch width: 2 ns (4 ns for PM 3382 and PM 3384). Pulse width time qualification: lower limit, upper limit, range.

Range of Limits for Glitch Triggering: 20 ns to 166 ms; resolution: 10 ns.

Delay

Time Delay: 0 to 1,000 div. continuously adjustable.

Pre-Trigger View: Up to 1 full record (160 div for an 8K record)

Event Delay: 1 to 16,384 events; maximum count rate: 50 MHz (typical); source: Ch1 to 4; modes: Event delay, Time delay after event delay

Delay Modes: Start after time delay or wait for trigger after time delay

Cursor Measurements

Cursor Modes: Horizontal, Vertical, Both; Free, Trace positioned

Readout Vertical: dV, V1 & V2 to GND, Ratio

Horizontal: dT, 1/dT (in Hz), Ratio, Phase

Calculated Measurements

Volt: DC, RMS, Minimum, Maximum, Peak to Peak, Low level, High level, Overshoot (positive and negative), Preshoot (positive and negative)

Time: Frequency, Period, Pulsewidth, Rise time, Fall time, Duty cycle

Delay: Channel to channel; rising and falling edges

Quick Measurement: Probe operated 'Touch & Hold' and instant calculated measurement of: Frequency, DC, RMS and Peak to Peak value

Processing

Standard: Add, Subtract, Multiply, Digital filter (For low pass filtering after single shot capture)

MATH+ Option: Integrate, Differentiate, FFT, Histogram

General Specifications

Interfacing

RS-232C Serial Interface: 9 pin D connector (for print/plot and full remote control). Handshake DSR/DTR, CTS/RTS and Xon/Xoff. Baudrate 75 to 38400.

Format: 1 Stopbit; 7 or 8 databits; odd/even/no parity. Protocol: CPL = Compact Programming Language = reduced set of powerful instructions for full remote control through RS-232C

GPIB/IEEE-488.2 Interface: Factory installed option. Remote control conform SCPI (Standard Commands for Programmable Instruments).

Waveform Dump: Trace dump to PM 5138 and PM 5139 arbitrary waveform generator

Hardcopy

Output: Printed or plotted hardcopy of the screen (digital mode) in sizable format and if selected together with a status report of the complete instrument setting

User Text: Two lines of on screen text for documentation

Interface: RS-232C; GPIB/IEEE488.2 optional.

Printers: FX Series, LQ1500 (24 pins), HP2225 (ThinkJet), HP LaserJet (series II and III) and compatibles

Plotters: HP 7440, HP 7550, HP 7475A, HP 7470A and compatibles

Camera: Bezels and Camera kit available as optional accessories

Miscellaneous

Setting Memory: 10 instrument setups, non-volatile

Calibration Output: 600 mV peak-peak (±1%), 2 kHz square (±20%)

Z-Modulation Input: BNC, 10 kΩ, >2.4V= blanked, <0.5V= unblanked. (analog mode only)

Time Between Calibration: 2,000 hrs or 1 year. (4,000 hrs or 2 years if error limits are doubled)

Probe: Automatic detection of indication ring or manual selectable scale factor

Power Supply

Line Voltage: 100V to 240V (±10%) in one range

Line Frequency: 50 Hz to 400 Hz (±10%)

Power Consumption: 115W (130W with all options installed)

Mechanical Data

Fan: Proportionally regulated forced air

Size: 139 mm H x 341 mm W x 481 mm L (5.5 in H x 13.4 in W x 18.9 in L) (excluding handle and feet);
147 mm H x 391 mm W x 551mm L (5.8 in H x 15.4 in W x 21.7 in L) (including handle and feet)

Weight: 9.5kg (21 lb)

Environmental Data

Meets: Requirements of MIL-T-28800D Type III, Class 3, Style D, Color R

Temperature: 0°C to +50°C (operating), 5°C to +40°C (use), -40°C to +70°C (storage)

Humidity: <=95% (storage)

Altitude: Max. 4.6 km = 15,000 ft (operating), 12 km = 40,000 ft (transport)

Vibration: Frequency 5 Hz to 55 Hz

Maximum Acceleration: At 55 Hz 30 m/s^2

Shock: 6 shocks along each axis, half sine wave, 6 to 9 msec, peak acceleration 400 m/s^2

Bench Handling: Meets MIL-STD-810, method 516, procedure V

Safety: Meets requirements of: IEC 348 Class I, UL 1244, VDE 0411, CSA C22.2 No 231 (approval applied for)

EMI: VDE 0871 Grenzwertklasse B; MIL-STD-461C: CE01 Part 2 (narrow band), CE03 Part 4, CS01 Part 2, CS06 Part 5 (300V max.), RE01 Part 5 and 6, RE02 Part 2 (1GHz max.)

Susceptibility: Deflection for extreme conditions: <0.7 div/mT for 1.42 mT peak-peak, 45 Hz to 66 Hz

Options

MEMORY⁺ Option

Acquisition Modes: 32K (single channel), 16K (dual channel), 8K (four channels) or 512 pts (to allow a maximum number of traces stored in reference memory)
Memory Size: Acquisition and reference memory allow total storage of: 3 traces of 32K samples, 6 traces of 16K samples, 12 traces of 8K samples or 200 traces of 512 samples

MATH⁺ Option

Additional Processing: Integrate, Differentiate, FFT, Histogram
Pass/Fail Testing: Test waveforms against reference envelope; Test calculated measurement against preset limits; Test cursor measurement against preset limits
Action On Violation: User selectable: Beep, Lock, Save acquisition, Print, Plot
Envelope Creation Internal: Draw on screen using cursor controls
Envelope Creation External: Down load from external PC
Advanced Cursors: Amplitude qualified cursors for timing measurements with time cursors automatically positioned relative to the signals: Max peak, Min peak, High level, Low level
Multiple Single Shot: For capturing up to 200 consecutive single shot acquisitions

GPIB/IEEE-488.2 Option

Protocol: SCPI = Standard Commands for Programmable Instruments = Standardized protocol. Fully compatible with IEEE-488.2.

Auxiliary Output/External Trigger Option

Factory Installed Option Includes:
Y-Out: BNC, 50Ω, 10 mV/div in 50Ω, 20 mV/div in 1 MΩ
MTB-Gate-Out: BNC, 1 kΩ, TTL compatible levels
DTB-Gate-Out: BNC, 1 kΩ, TTL compatible levels

External Trigger Input with the Following Characteristics

MTB Trigger Source: CH1..4, composite, external
Impedance: 1 MΩ
Coupling: AC, DC, LF-rej (30 kHz), HF-rej (30 kHz)
Slope: Positive (+) or negative (-)
Trigger Gap: 80 mV; trigger gap can be doubled for triggering on noisy signals
Bandwidth: Sensitivity at 10 MHz: < 80 mV
Input Amplifier: Dynamic range of the DC coupled input amplifier:
-2.5V to +2.5V (on BNC connector)
-25V to +25V (on probe tip of 1:10 probe)
Maximum Input Voltage: 400V peak

Ordering Information

Models

PM 3382 100 MHz CombiScope with 2 + 2 Channels and Delayed Time Base
PM 3384 100 MHz Full 4 Channel CombiScope with Delayed Time Base
PM 3392 200 MHz CombiScope with 2 + 2 Channels and Delayed Time Base
PM 3394 200 MHz Full 4 Channel CombiScope with Delayed Time Base

Included with Instrument

Three-year product warranty, parts and labor, five-year CRT warranty, two 100 MHz 10:1 probes, model PM 9010/091, with 1.5m (5 ft) cable and scale factor readout (PM 3382/84); two wide bandwidth 10:1 probes, model PM 9020/091, with 1.5m (5 ft) cable and scale factor readout (PM 3392/94), blue CRT contrast filter, front cover, operator and reference manual (IEEE-488 versions include a programming manual) (a service manual is available upon return of reply card included with each instrument), and Certificate of Calibration Practices.

Optional Configurations

When ordering, select basic 'PM' model number, and add the configuration option number listed below as a suffix.

/00n Standard Version
/02n MP (Math+)
/06n EM (Extended Memory)
/08n MP + EM
/40n IEEE-488 (GPIB/IEEE-488.2 interface with SCPI)
/42n IEEE-488 + MP
/46n IEEE-488 + EM
/48n IEEE-488 + MP + EM
/91n IEEE-488 + AuxOut/ExtTrig
/93n IEEE-488 + MP + AuxOut/ExtTrig
/97n IEEE-488 + EM + AuxOut/ExtTrig
/99n IEEE-488 + EM + MP + AuxOut/ExtTrig

All options are factory installed only.

The n' indicates the required line cord. To select your line cord substitute the n' by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

Example, Ordering Configuration

To order a 200 MHz, full four channel Digital Storage Oscilloscope with Extended Memory and Math+, plus GPIB/IEEE-488 interface installed, and U.S. line cord select:

	Model
Basic Oscilloscope	PM 3394
MP + EM	/083
GPIB/IEEE-488	/403
Complete Model Number	PM 3394/483

Accessories (Also see end of Section 2)
Passive Probes
PM 9011/001 Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 100 MHz (in 10:1 mode), 10 MHz (in 1:1 mode)
PM 9021/001 Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 200 MHz (in 10:1 mode), 10 MHz (in 1:1 mode)
PM 9001/001 Modular 1:1 Probe, 1.5m (5 ft) Cable
PM 9001/091 Modular 1:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 9001/201 Modular 1:1 Probe, 2.5m (8 ft) Cable
PM 9001/291 Modular 1:1 Probe, 2.5m (8 ft) Cable, Auto Range Indicator and Command Button
PM 9010/001 Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable
PM 9010/091 Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 9010/201 Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable
PM 9010/291 Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable, Auto Range Indicator and Command Button
PM 9020/001 Modular 200 MHz 10:1 Probe, 1.5m (5 ft) Cable
PM 9020/091 Modular 200 MHz 10:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 9100/001 Modular 100:1 Probe, 1.5m (5 ft) Cable
PM 9100/091 Modular 100:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 8918/002 Set of two 10:1 Probes, one Grey, one Red, 1.5m (5 ft)
PM 8918/202 Set of two 10:1 Probes, one Grey, one Red, 2.5m (8 ft)

Active Probes
PM 8940/09n High Voltage Isolation Amplifier with Auto Range
PM 8943A/00n 650 MHz FET Probe
PM 9355/09n 70 MHz AC Current Probe with Auto Range

The n' indicates the required line cord. To select your line cord substitute the n' by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

PM 3382, PM 3384, PM 3392 & PM 3394

Other Accessories

PM 8902A/001 12V DC Power Inverter
PM 8903A/00n Battery Pack, Charger, Inverter and Carrying Case
PM 8917/00n NTSC and PAL Video Sync Separator and Line Selector
PM 8960/04 Retrofittable Rack Mount
PM 8978/011 Adapter for PM 9381 Camera
PM 8978/021 Adapter for Tektronix® Camera
PM 8992/80 Accessory Pouch
PM 8989/031 Traveller Carrying Case
PM 8991/041 Oscilloscope Cart
PM 9051 BNC to 4 mm Banana Adapter
PM 9381 Oscilloscope Camera System
PM 2122/002 50Ω Coaxial Switch
PM 2255/001 Series Instrument Driver Software
PM 2270/003 DSO COM, RS-232 Waveform Transfer Software
PM 2273/001 AnyWave Waveform, Template and Pass/Fail Testing Software
PM 9372/002 Telephone Communication Software for Service Support Applications
TC100 Instrument Cart
TC 100-01 Optional Power Strip for TC100 (U.S. only)
TC 100-02 Optional Drawer for TC100
TC 100-03 Optional CPU Bracket for TC100
TC 100-04 Optional Power Strip, Drawer, and CPU Bracket for TC100 (U.S. only)

The n' indicates the required line cord. To select your line cord substitute the n' by:

1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

Manuals

PM 33xx Operator's Guide*
PM 33xx Reference*
PM 33xx Service
PM 3382 Operators*
PM 33xx Math Function Guide
PM 339x SCPI Programming*

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

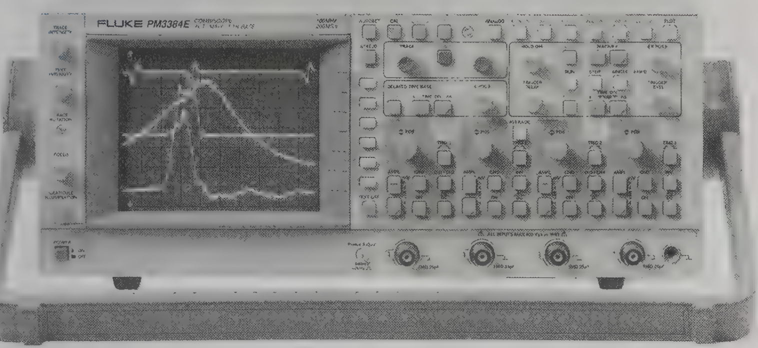
Factory Warranty

Three-year product warranty. Five-year CRT warranty.

PM 3384E

RS-232

NEW



PM 3384E

Four Channel CombiScope with Automatic Time Base Mode

- Four channels - Analog and Digital
- Amplitude readout in engineering units, depending on transducer used
- Continuously variable time base mode - Analog and Digital
- Automatic Time Base mode - display constant number of cycles automatically, regardless of frequency
- Set Time Base in time/div, or °/div
- Time base and cursor readouts in time, or degrees
- Direct readout of Frequency and RPM
- Signal Averaging and Digital Filtering for noise reduction
- PASS / FAIL testing to detect run-away and fault conditions
- Extensive Math capabilities, including FFT, standard
- Full screen printing or plotting for complete documentation
- Serial interface for computer support and remote monitoring capabilities

Four Channels

The PM 3384E CombiScope™ offers four full sensitivity channels to allow signal monitoring and measurements in complex systems. Examples include performance testing of multi standard video systems and monitors and to monitor the signals in complex electrical, electronic, mechanical or electromechanical installations. Each of the four channels can be set and calibrated to represent the actual value and units of measurement pertaining to that channel: Voltage, Current, Temperature and Pressure can be read in the dimension of the transducer used.

Complete CombiScope

The PM 3384E is a full four channel CombiScope with all features and capabilities included as published for the PM 3384/08n on pages 6 - 12.

Time Base Readout in Degrees

The time base can be set in the traditional oscilloscope way - in seconds, or fractions thereof. But in the AUTO Time Base mode, the time base speed can be manually set to a desired number of degrees to be displayed on the screen.

Automatic Time Base Mode

The Automatic Time Base mode allows the oscilloscope to display a user selectable number of degrees of a signal cycle. This way, the number of degrees displayed, or the number of cycles displayed is kept constant, even if the signal frequency changes. Fast Digital Signal Processing (DSP) assures fast update and adjustment.

Automatically Follow Changes in Frequency or Phase

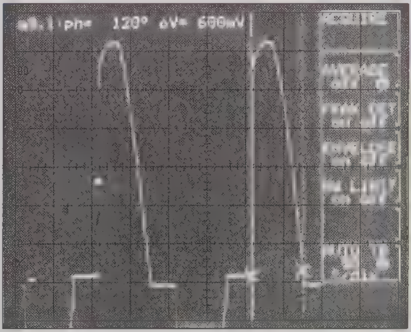
The Automatic Time Base mode gives hands free operation of the PM 3384E where normally you would have to continuously adjust the time base control. Examples include frequency response testing, VCOs, variable frequency transducers.

The degrees per division (°/div.) mode of the time base automatically detects the 360° of a full cycle in the input signal for use with timing and cursor measurements. This provides for easy to use and accurate phase measurements. Examples are found in SCR firing, power control and positional (servo) control systems.

Used in Multi Standard Video

The four channels make the PM 3384E very suitable for video work. See R, G, B as individual channels. Use the fourth input channel and the external trigger input for sync.

The AUTO Time Base mode is particularly useful when testing and verifying multi standard video systems and monitors. When the signal standard changes, so does the Line and Frame frequency. The scope adjusts automatically.



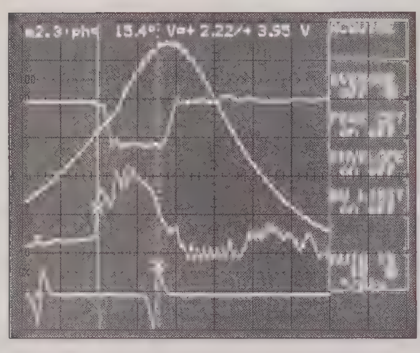
Used in Engine Monitoring

The four channels of the PM 3384E permit the simultaneous capture and display of the waveforms most frequently used in engine monitoring applications : pressure curve from the combustion chamber, fuel pump, needle lift or injection pulse, and time marking signals.

Customizable amplitude scaling permit the amplitude readout to be in PSI or Pascal, depending on the transducer in use. Each channel can be individually calibrated to its own transducer and appropriate scale factor. Cursor readouts and calculated measurements automatically adjust for the scale factor in use - regardless of input channel.

Especially attractive and appropriate for most engine engineering applications is the ability of the time base to provide a direct readout of crank angle in degrees. The AUTO Time Base mode keeps the most significant angle of 90° from the complete engine cycle displayed over a constant number of divisions, even when the RPM changes.

PM 3384E



Typical waveforms taken from an actual Diesel Engine under test. Waveforms represent cylinder pressure, needle lift, fuel pressure, and time marking signals. The oscilloscope was used in the AUTO Time Base SnapTM mode, allowing the operator to adjust engine RPM without readjusting the scope's time base.

Note the always calibrated time base speed displayed in the bottom of the screen. Even when speeds outside the traditional 1-2-5 time base sequence are selected - either by the operator or the scope itself - these speed are properly represented by the waveform data printed on printers and plotters, or output to a computer.

User selection of two stroke or four stroke engine is done in a menu.

Continuous readout of engine RPM, Peak pressure, injector pulse width and time (or degrees) between injector opening and Top Dead Center (TDC) are included.

Ample Memory for Optimum Resolution

The user selectable memory length allows the user to display just a part of an entire signal cycle or display a selectable number of cycles on the screen. At record lengths of 512 points, the time base resolution can be set in increments of 90°/div. At record lengths of 4K per channel, the time base can be set in steps of 10°/div. In the example of engine monitoring, this would permit the display of the most critical portion of the total engine cycle (usually 90° of crank angle), on the screen while still permitting the capture of the full engine cycle of a four stroke combustion engine in memory.

Measurements in Engineering Units

Built-in measurement routines make signal monitoring easy. Besides the timing readout to be selectable between time and degrees per division, the vertical scales can be fully customized to the application. When used with the standard or optional probes, scale factors are automatic and in Volts. But when other probes or transducers are used, the amplitude scales and associated measurements are fully customizable and can be calibrated in the measurement units of the transducer used.

Math Capabilities to Learn More About Your Signals

Signal Averaging is provided to suppress noise from noisy transducer signals and to take full advantage of the oscilloscope's 16 bit data path. This greatly improves measurement accuracy.

Digital Filtering is standard. It allows the user to suppress the influence of noise - even on non repetitive signals, or on signals that have been stored previously.

FFT provides information about the spectral content of a signal. The PM 3384E has an FFT update rate of 10 calculations per second!

Easy Documentation on Paper

Documentation of signals is easy. Traditional screen photography is easy with the PM 9381 oscilloscope camera described on page 44. The RS-232 interface (standard) provides direct output to a choice of dot-matrix printers, ThinkJet printers, Laser Printers, and digital plotters. In addition, the RS-232 interface makes it easy and efficient to store waveforms in computers for documentation and filing.

Selectable HPGL compatible output allows the publication of word processed documents with professional waveform data.

A Complete CombiScope

All of the features and capabilities of the PM 3384/08n described on pages 6 thru 12 are provided. This includes the capability to save up to 200 waveforms, full waveform math, and FFT.

The PM 3384E has special firmware that is optimized for troubleshooting signals in a variety of frequency standards and for monitoring and analyzing combustion engines.

Easy Setup

All of this power is easy to use. Fast set-up is further enhanced by the scope's ability to store up to 10 complete setups in its own memory. These are recalled at the touch of a button. More setups can be stored in a host PC and downloaded through the RS-232 interface - even through phone lines.

Specifications

All specifications are identical to those of the PM 3384, on pages 9 thru 12 except for the following.

Analog Mode

Trigger Source: External trigger via BNC connector on rear panel

Digital Mode

Trigger Source: Same as analog mode

Time Base

Variable time base in DSO mode, variable time base step sizes

Range	Resolution
100 ps to 1 µs	1-2-5 steps
1 µs to 100 µs	1 µs steps
100 µs to 200s	same as step size in PM 3384 analog mode

Automatic Time Base

Automatic Modes: degrees/division or periods/screen

Automatic Time Base Operation: Time mode 1-2-5 steps. Displays between 2 and 6 waveform periods on screen. Time mode variable: same step sizes as manually variable time base. Degrees/division mode.

Degrees Mode Time Base Range degrees/div	**Time Mode** Time Base Range Periods/Screen	**Memory Depth**
90° to 360°	2.6 to 10	0.5K
10° to 360°	0.4 to 10	4K
5° to 360°	0.2 to 10	8K

Acquisition

Record Length: 4 channels of 0.5K; 4 channels of 4K; 4 channels of 8K; 2 channels of 16K; 1 channel of 32K

Cursor Measurements: Automatic measurement in DEGREES mode. The trigger point is the 0° reference. The 360° point is automatically set.

MODES: Phase 1 and Phase 2 referenced to trigger point. Phase (phase difference) between cursors.

Calculated Measurements: RPM (degrees mode only); Pulse width in degrees; Rise time in degrees; Fall time in degrees

General

Interfacing: RS-232C standard; GPIB not available

Miscellaneous

Probe Scaling: Pressure units, symbol "P" added for readouts in PSI or Pascal

Ordering Information

Model

PM 3384E/10n 4 Channel CombiScope with Automatic Time Base Mode

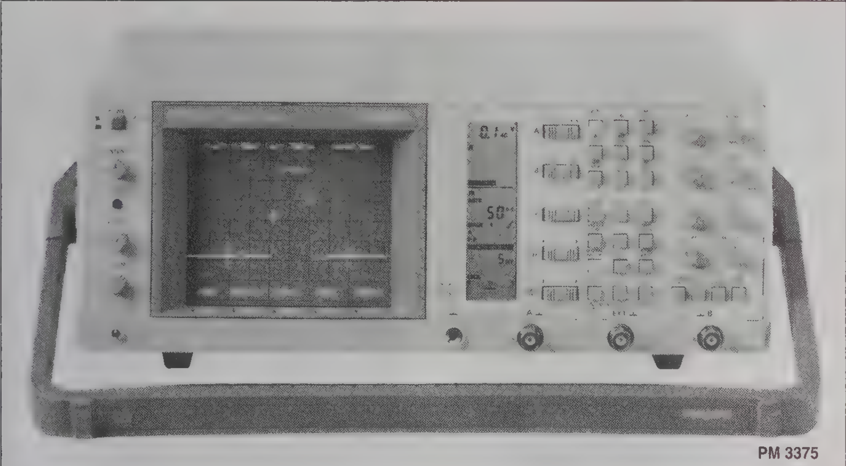
The n' indicates the required line cord. To select your line cord substitute the n' by:

1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

PM 3375, PM 3355, PM 3365A, & PM 3350A

GPIB
IEEE-488

RS-232



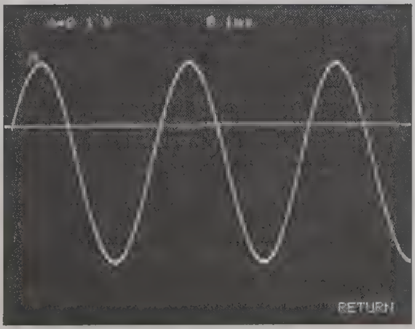
PM 3375

PM 3375/55 & PM 3365A/50A CombiScopes

- Switch from Digital Storage to Analog operation and back for digital accuracy and analog familiarity
- Choose up to 250 MS/s real time sampling on each channel
- Choice of 100 MHz and 60 MHz bandwidth models
- 100 MHz models include repetitive sampling for 100 MHz signal capture
- Extensive and stable triggering up to 150 MHz
- Digitally Delayed sweep for signal detail capture and observation
- AUTOSET for quick setup, operates in both modes
- Store up to 8 traces for easy comparison of signals
- Signal Averaging and Envelope acquisition
- Extensive automatic cursor measurements
- 64 Front panel setup memories, for routine measurements
- Full programmability in both modes thru GPIB/IEEE-488 or RS-232C interfaces

Combination of DSO and Analog Modes

The PM 3375, PM 3355, PM 3365A and PM 3350A CombiScopes™ described in this section combine the familiarity of analog oscilloscopes with the signal capturing and measurement power of modern Digital Storage Oscilloscopes (DSO). Switching between both modes is at the touch of one button, and can be done at any moment. This is of great value for reference and comparisons. It also permits the optimal use of each operating mode to suit every measurement need. And finally, it adds confidence to every measurement situation.



Excellent CRT displays ensure crisp and bright displays in the analog mode.

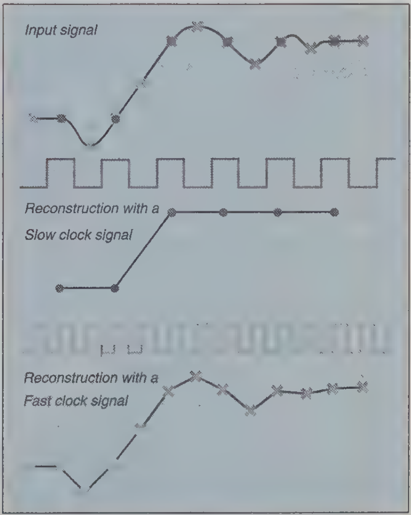
High 250 MS/s Real Time Sampling

The PM 3375 and PM 3355 offer an unequalled real time sampling speed of up to 250 MegaSamples per second (MS/s) for high time resolution of repetitive, low repetition rate or single shot signals unprecedented in these instrument's price ranges. The time resolution in the real time mode is 4 ns to reveal details of fast signal transitions, glitches and signal details. This speed covers most present needs and allows for future technologies as well.

For less demanding applications, and at a lower cost, the PM 3365A and PM 3350A offer up to 100 MS/s real time sampling speed.

A summarized reference of major characteristics for these instruments is as follows:

	PM 3350A	PM 3365A	PM 3355	PM 3375
Sample Rate	100 MS/s	100 MS/s	250 MS/s	250 MS/s
Bandwidth	60 MHz	100 MHz	60 MHz	100 MHz



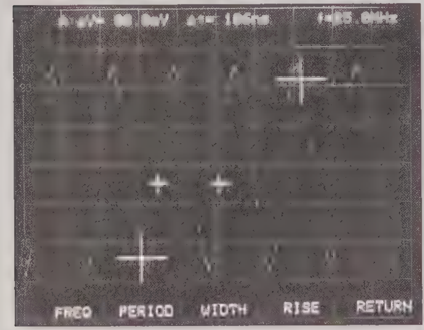
Accurate reconstruction of the original waveform is mainly dependent on the instrument's sample rate. Increased sample rate means improved accuracy and resolution.

Simultaneous Real Time Sampling

At all sampling speeds, all of these models offer simultaneous sampling between channels, up to their highest sampling speed of 250 MS/s and 100 MS/s respectively, so that no time resolution performance is lost when both channels are in use. This is an important consideration to assure best resolution signal capture, as well as to maintain accurate timing between channels.

PM 3375, PM 3355, PM 3365A, & PM 3350A

Choice of 100 MHz and 60 MHz Bandwidth Models to Suit Actual Needs and Budgets



The PM 3375 and PM 3365A digitize signals up 100 MHz.

Choose the bandwidth you need, and balance your budget. The PM 3375 and PM 3365A offer a full 100 MHz bandwidth, in both modes of operation, and include repetitive sampling to permit signal capture of repetitive signals up to 100 MHz. Triggering is up to 150 MHz.

The PM 3355 offers the same real time sampling speed as the PM 3375, but does not offer repetitive sampling. Bandwidth of the PM 3355 is 60 MHz in the analog mode. In the DSO mode, the PM 3355 maximum captured frequency is determined by the maximum sampling speed of 250 MS/s, divided by a factor of 10, or 25 MHz.

The PM 3350A offers up to 100 MS/s, and also has a 60 MHz bandwidth.

Fast and Stable Triggering, Versatile Trigger Features

Trigger bandwidth of all models is high, for stable signal acquisition of high frequency signals, as well as short events and glitches. For added immunity to signal noise, trigger filters are provided, giving effective suppression of high frequency, or low frequency signal noise. Video signals are easily triggered too, with both Vertical sync, or Horizontal sync separators built in. Triggering is easy, thanks to an Automatic trigger mode including automatic peak-to-peak detection for repetitive signals. Also included is a Trigger View mode to quickly set and verify the proper level when capturing non-repetitive signals.

Multiple Operating Modes Add Versatility

All of these instruments can be operated as normal, familiar, analog oscilloscopes.

At the touch of one button, the instrument becomes a powerful DSO. In the DSO mode of operation, the user can choose from a variety of acquisition modes. Automatic acquisition of repetitive signals, with the familiar base line when no signal is present. Or a Triggered mode, in which repetitive signals can be captured down to the lowest repetition rates, even single shots. A dedicated Single Shot mode permits the capture of single events, without the risk of re-triggering until the user resets the scope. A unique Multiple Single Shot mode permits two events to be captured and stored in two different memory locations. The second event can be immediately after the first, or hours later. This is a very useful feature to capture elusive or intermittent events. For very low frequencies, captured at very low timebase speeds down to 50 s/div, the scope automatically switches to a Roll mode. The Roll mode includes a trigger feature, so that it can be stopped when a signal exceeds a preset trigger level.

High Sensitivity and High Accuracy

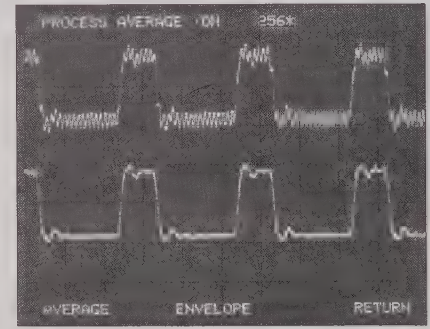
These models offer sensitivities of up to 2 mV/div, without using signal expansion. This means that even at the highest sensitivity setting, the full 8 bit resolution and associated accuracy is maintained.

Full range attenuators include 10 V/div settings as well, for excellent signal acquisition versatility at higher amplitudes.

Probe Recognition is Automatic

All measurements and settings incorporate the attenuation factor of the standard probes delivered with the instruments, when used. This is also true for a variety of optional probes listed in this catalog.

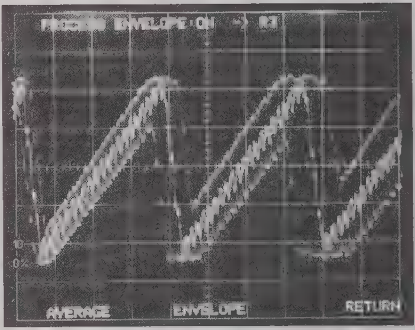
Signal Averaging



Averaging effectively improves accuracy in repetitive and noisy signals. Trigger filters further enhance the stability in the acquisition of noisy signals.

Some signals are masked by noise, making accurate measurements difficult. These scopes effectively reduce the effects of noise by a Signal Average function, operated at the touch of one softkey. A running average of successive acquisitions in a repetitive signal is calculated and displayed, reducing the influence of noise by the square root of the number of averages. The number of averages can be selected up to 256 times.

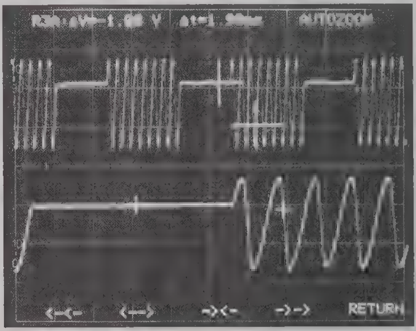
Signal Envelope



The "Envelope mode" makes it possible to capture signal variations over time, for example through temperature changes, interference, offset drift, etc.

Signal variations over time can be captured by the built-in Envelope Mode. Using this mode, the instruments can capture glitches, amplitude modulated waveforms, frequency modulation, and jitter. The envelope is stored in a separate memory, so that comparisons between an actual signal, and the envelope built up over time, can be easily made.

Digitally Delayed Sweep



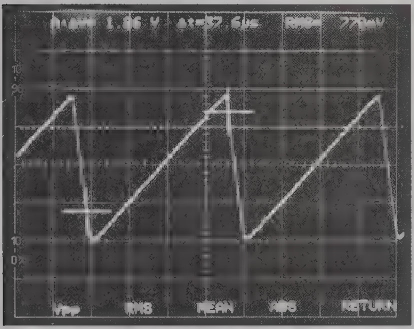
Digitally Delayed Sweep, using the unique AUTOZOOM feature lets you identify any signal detail with the cursors, for capture with greater resolution (lower trace).

In applications where delayed sweep would be used in an ordinary scope, the built-in Digitally Delayed Sweep capabilities are powerful, and truly appreciated. Delay is derived from the system clock, and it is more stable than is the case in analog instruments. The built-in cursors can be used to highlight a signal detail to be captured and displayed after an appropriate delay, at higher time base resolution. This innovative cursor-assisted delay greatly facilitates operation.

Pretrigger Recording

One of the inherent benefits of a DSO is its ability to acquire and display signal details happening before the actual trigger signal. In these oscilloscopes, pretrigger can be adjusted in one division increments, all the way up to a full screen of pretrigger recording.

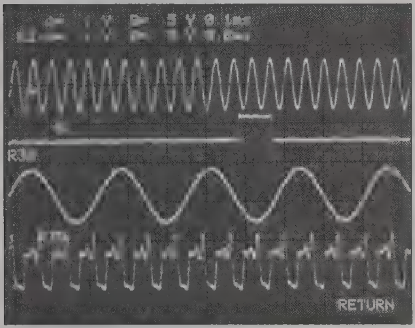
Cursors



Example of a calculated measurement: RMS amplitude. Please note that the Ground line is displayed as reference.

These instruments offer cursors which can be assigned to each of the eight traces in memory. But besides the voltage differential and time difference measurements offered by most DSOs, there is a host of calculated measurements, including Peak-to-Peak, Absolute-to-Ground, and RMS amplitude, as well as Frequency, Period and Rise time and Fall times.

Memories



Multiple registers for non-volatile storage of waveforms and relevant acquisition parameters.

Four 4K deep memories permit storage of two signals each. This makes comparisons between new and reference signals easy. Cursors can access each waveform, in each of the memories.

Ease of Use Features

AUTOSET is found on every CombiScope in this catalog. It automatically finds the signal on either input, selects the proper trigger signal, and adjusts amplitude and time base. In this family of scopes, AUTOSET works in both operating modes: when used as analog scope and as a DSO.

Up to 64 front panel settings can be stored, to permit easy execution of routine measurements.

All selected instrument setups are easily read in the large, backlit LCD display adjacent to the screen, leaving the CRT uncluttered, and providing instrument status at a glance. Probe factor readout is automatic, with the probes supplied, as well as with the optional Philips probes.

Remote Control and Hard Copy Output

The optional GPIB/IEEE-488* or RS-232C interfaces permit full control of all acquisition and measurement functions of these scopes. Programming is straight forward, and an efficient bus learn mode is provided to facilitate application program development. Software is available for application programs development, waveform analysis, waveform transfer utilities, and remote diagnostics, using telephone lines.

Each interface also includes the ability to provide direct hard copy output to digital plotters and printers.

Low Cost of Ownership

Besides the highly competitive pricing for each of these instruments, low cost of ownership is assured by quality engineering using high quality components and conservative component ratings. Modular construction makes for easy access and fast service. A three year warranty is standard.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Power Source Flexibility and Battery Power

The power supply of each of these instruments automatically adjusts to any line voltage between 100 volts and 240 volts nominal. Frequencies between 46 and 440 Hz are also accepted. Due to the low power consumption of these instruments, operation from 12V dc or rechargeable battery packs is also possible. See the accessories section for details on PM 8902A and PM 8903A dc supply sources.

How to Select Your Best Instrument

The PM 3375 and PM 3355 provide the highest real time sampling rate of this family of instruments: 250 MS/s.

The PM 3350A and PM 3365A offer 100 MS/s real time sampling.

The PM 3375 and PM 3365A have the same bandwidth of 100 MHz, and include repetitive sampling so that 100 MHz repetitive signals can be digitized.

The PM 3350A and PM 3355 have the same bandwidth: 60 MHz. They lack repetitive sampling.

Trigger delay of the PM 3375 and PM 3355 is up to 5,000 divisions; that of the PM 3350A and PM 3365A is up to 2,500 divisions.

All other features and options are equal for each of these instruments.

With this choice, the best optimum between performance and price can be selected from the table below:

	PM 3375	PM 3355	PM 3365A	PM 3350A
Real time Sampling	250 MS/s	250 MS/s	100 MS/s	100 MS/s
Repetitive Sampling	Yes	No	Yes	No
Bandwidth	100 MHz	60 MHz	100 MHz	60 MHz
Maximum Captured Frequency				
Repetitive Signals	100 MHz	25 MHz	100 MHz	10 MHz
Single Shots	25 MHz	25 MHz	10 MHz	10 MHz
Trigger Delay	5,000 div	5,000 div	2,500 div	2,500 div
All other features	Same	Same	Same	Same

Note: The maximum captured frequency is calculated by dividing the maximum real time sampling rate in MS/s by a factor of 10.

PM 3375, PM 3355, PM 3365A, & PM 3350A

Specifications

Technical Specifications

AUTOSET: Automatically sets all parameters (attenuator, time base and trigger source) for an optimum waveform display, typical within 3 seconds.

Analog Mode

Vertical

Display Modes: Ch A, Ch B, -Ch B, Ch A + Ch B, Ch A - Ch B (ALTernate or CHOPped)

Frequency Response
PM 3350A/55: DC to >60 MHz -3 dB (20 mV/div to 10V/div); dc to >35 MHz -3 dB (2 mV/div to 10 mV/div);
PM 3365A/75: DC to >100 MHz -3 dB (20 mV/div to 10V/div); dc to >75 MHz -3 dB (2 mV/ div to 10 mV/div)
AC Mode: lower -3 dB point is <10 Hz

Rise Time
PM 3350A/55: <5.8 ns (20 mV/div to 10V/div); <1 ns (2 mV/div to 10 mV/div)
PM 3365A/75: <3.5 ns (20 mV/div to 10V/div); <4.7 ns (2 mV/div to 10 mV/div)
Deflection Coefficient: Calibrated: 2 mV/div to 10V/div in 1, 2, 5 sequence; continuous control ratio between steps: 1 to >2.5
Error Limit: ±3% in calibrated position
Input Impedance: 1 MΩ ±2%//20 pF ±2 pF
Max Input Voltage: 400V (dc + ac peak)
CMRR: 100:1 at 1 MHz

Dynamic Range
PM 3350A: 24 div at 10 MHz; >8 div at 60 MHz
PM 3365A: 24 div at 10 MHz; >8 div at 100 MHz
PM 3355: 24 div at 10 MHz; >8 div at 60 MHz
PM 3375: 24 div at 10 MHz; >8 div at 100 MHz

Horizontal

Display Modes: Time base (for Y-t operation), X-deflection (for X-Y operation)
Time Base: 0.5 s/div top 50 ns/div in steps of 1, 2, 5 sequence, continuous control ratio between steps: 1 to >2.5
Expansion: x10, fastest sweep speed 5 ns/div
Error Limit: ±3% in calibrated position; ±4% in x10 expansion
Hold Off: Continuously adjustable up to 10x minimum value

Triggering

Trigger Modes: Auto (free run), non-auto triggered, single sweep
Trigger Sources: ChA, ChB, Composite (ChA/ChB), external, line
Trigger Coupling: Auto p-p; DC, TVF, TVL, LF reject, HF reject; for external dc or ac
Trigger Slope: Positive, negative; for TVF/TVL positive or negative video
Trigger Indication: LCD status indication; triggered, no triggered, armed, not armed

Trigger Sensitivity

PM 3350A/55	Internal	External
10 MHz	0.5 div	50 mV
50 MHz	1.0 div	150 mV
100 MHz	2.0 div	500 mV
TVF/TVL	0.7 div sync	70 mV sync
Level Range	±8 div	±800 mV

PM 3365A/75	Internal	External
10 MHz	0.5 div	50 mV
100 MHz	1.2 div	150 mV
150 MHz	2.0 div	500 mV
TVF/TVL	0.7 div sync	70 mV sync
Level Range	±8 div	±800 mV

X-Deflection

Deflection Source: ChA, ChB, external
Deflection Coefficient: 2 mV/div to 10V/div (external: 100 mV/div)
Frequency Response: DC to 1 MHz
Error Limit: ±5%
Phase Shift: <3% at 100 kHz
External Input Impedance: 1 MΩ ±2%//20 pF ±2 pF
Max Input Voltage: 400V (dc + ac p-p)

Digital Mode

Digital Acquisition and Display Modes: Ch A, Ch B, -Ch B, Ch A and + or - Ch B (sampled simultaneously). For A - B Digital Storage modes, refer to PM 3382 thru PM 3394 sections in this catalog.

Acquisition

Maximum Sample Rate: Real time - PM 3350A/65A, 100 MS/s simultaneously on both channels; PM 3355/75, 250 MS/s simultaneously on both channels. Equivalent time - PM 3365A/75, 2.5 GS/s.
Maximum Captured Frequency: Single Shot Signals - PM 3350A/65A 10 MHz* (BW limited to 25 MHz); - PM 3355/75 25 MHz* (BW limited to 35 MHz);
Repetitive signals - PM 3350A, 10 MHz*;
PM 3355 25 MHz*; PM 3365A/75, 100 MHz
Processing: Average, Continuous when activated: Weight selectable at 1/2, 1/4, 1/8, 1/16, 1/128, 1/256. Envelope, Continuous when activated; in single or multiple shot mode on an incremental basis.

Vertical

Resolution: 8 bits
Acquisition Modes: ChA, ChB, -ChB

Frequency Response

	20 mV/div to 10V/div	2 mV to 10 mV/div
PM 3350A	DC to >20 MHz (-3 dB)	
PM 3365A	DC to >100 MHz (-3 dB)	DC to >75 MHz (-3 dB)
PM 3355	DC to >35 MHz (-3 dB)	DC to >20 MHz (-3 dB)
PM 3375	DC to >100 MHz (-3 dB)	DC to >75 MHz (-3 dB)

Horizontal

Resolution Single Channel: 4096 samples/acquisition at sweep speed slower than 0.2 ms/div. 512 samples/acquisition at sweep speed equal to or faster than 0.2 ms/div
Resolution Dual Channel: 2048 samples/acquisition at sweep speed slower than 0.2 ms/div. 512 samples/acquisition at sweep speed equal to or faster than 0.2 ms/div
Acquisition Modes: Recurrent, single shot, multiple shot (up to 2). Roll (stopped by trigger), and AUTOZOOM.
Time Base, Real Time: Recurrent, single and multiple shot;
PM 3350A/65A; 0.5 s/div to 0.5 µs/div
PM 3355/75; 0.5 s/div to o.2 µs/div
Roll, 50 s/div to 1s/div
Time Base, Equivalent Time: Recurrent,
PM 3365A; 0.2 µs/div to 20 ns/div
PM 3375; 0.1 µs/div to 20 ns/div
Timing Accuracy: ±0.1%
Expansion: x1 to x 32

Triggering

Trigger Modes: Auto (free run), non-auto triggered, single sweep, multiple sweep (up to 2)

Trigger Delay Real Time
PM 3350A & PM 3365A: 10 div to 2,500 div;
PM 3355 & PM 3375: 10 div to 5,000 div
Trigger Delay - Equivalent Time: 0 div to 20 div (PM 3365A & PM3375)

Memory: Non-volatile; battery backed storage for up to 3 years
Waveform Storage: Max 16K (8 traces)
Front Settings Storage: Max of 64 settings can be stored and recalled at random

Cursors

Horizontal Resolution: Single Channel, 1:4,096 over 10 div. Dual Channel, 1:2,048 over 10 div. -2 ms/div to 20 ns/div; 1:512 over 10 div: 1:1024 in dot-join mode over 10 div
Vertical Resolution: 1:256 over 10 div
Real-Out Resolution: 3 digits
Measurements: Cursor; dv, dt. Automatically calculated; Vp-p, Vrms, V mean, Vabs, frequency, period, pulsewidth, rise/fall-time

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* *The maximum captured frequency is calculated by dividing the maximum real time sampling rate in MS/s by a factor of 10.*

Interfacing

Option/40: GPIB/IEEE-488.1
Option/50: RS-232C

GPIB/IEEE-488.1

Bus Driver: E2 (three state)
Function Repertoire: SH1, AH1, T5, L3, SR1, RL2, PP0, DT1, DC1, C0

RS-232C

Handshake: Software XON/XOFF; hardware DSR/DTR & CTS/RTS
Baud Rate: Transmit 75 to 19,200; receive 75 to 1,200
Stop Bits: 1 or 2
Parity: Odd, even or none
Character Length: 7 or 8 bits

Digital Plotter (Only with option/40 or /50)

Language: HPGL or Philips GL
Plotter Select: PM 8153/1, PM 8153/6, PM 8154, PM 8155, HP 7450, HP 7475A (PM 8155 plotter selection is also suitable to drive the digitally controlled XY recorders PM 8277 and PM 8278)
Pen Select: Pen 1 for ChA; Pen 2 for ChB; Pen 3 for reference register ChA; Pen 4 for reference register ChB; Pen 5 for graticule and alphanumerics
Plot Area: Softkey selectable

Matrix Printer

Screen Dump: Epson FX80, HPThinkJet, compatibles
Print Area: 10 cm x 10 cm

XY Recorder

Output Level: 1V/full memory ±3%
Penlift: TTL compatible
Plot Time per Sample: 20 ms to 2000 ms
Connector: DIN-plug 9-pin female
Functions: Memory dump, register selectable
Output Sequence: Ch A first

General Specifications

Display

CRT with 8 x 10 cm viewing area, P31 phosphor, 16 kV acceleration voltage. Parallax-free graticule with continuously variable illumination. Separate backlit LCD for display of status information, settings, etc. Softkey display area on CRT for selection of menu choices.

Power Supply

Line Voltage: 100V to 240V ac ±10% in one range
Line Frequency: 50 Hz to 400 Hz ±10% in one range
Power Consumption: PM 3350A 70W; PM 3365A 75W; PM 3355 80W; PM 3375 85W

Environmental Data

Meets requirements of MIL-T-28800C, Type III, Class 5, Style D
Temperature: Range of use, 10°C to 40°C; range of operation, 0°C to 40°C; range of storage, -40°C to 75°C
Operating Altitude: 4,500m (15,000 ft)
Transport Altitude: 12,000m (40,000 ft)
Vibration: Frequency 5 to 55 Hz, max acceleration 30 m/s^2
Shock: 6 shocks on each axis, half sinewave, 11 ms, peak acceleration 300 m/s^2
EMI: Meets requirements of MIL-STD-461 Class B, VDE 0871 Grenzwertklasse B
Safety: Meets requirements of IEC 348 Class 1, VDE 0411, UL 1244, CSA 556B certified

Mechanical Data

Width: 387 mm (15.2 in) incl handle; 350 mm (13.8 in) excl handle
Length: 530.5 mm (20.9 in) incl handle and knobs; 455.5 mm (17.9 in) excl handle incl knobs; 433.5 mm (17.1 in) excl handle and knobs
Height: 146.5 mm (5.8 in) incl feet; 134.5 mm (5.3 in) excl feet
Weight: 9.5 kg (20.9 lb)

Ordering Information

Models

PM 3375 100 MHz CombiScope, 250 Ms/s
PM 3377 Same, with Rack Mount
PM 3355 60 MHz CombiScope, 250 Ms/s
PM 3357 Same, with Rack Mount
PM 3365A 100 MHz CombiScope, 100 Ms/s
PM 3367A Same, with Rack Mount
PM 3350A 60 MHz CombiScope, 100 Ms/s
PM 3352A Same, with Rack Mount

Included with Instrument

Three-year product warranty, parts and labor, five-year CRT warranty, two 100 MHz 10:1 probes, model PM 8926/591 or equivalent, with 1.5m (5 ft) cable and scale factor readout, protective front cover, model PM 8988/001 (PM 3365A and PM 3375 only), blue CRT contrast filter, operator and reference manual (a service manual is available upon return of reply card included with each instrument), and Certificate of Calibration Practices.

Optional Configurations

When ordering, select basic "PM" model number, and add the configuration option number listed below as a suffix.

/00n Standard Version
/40n Basic Configuration, with GPIB/IEEE-488 Interface
/50n Basic Configuration, with RS-232C Interface

All options are factory installed only.

The n' indicates the required line cord. To select your line cord substitute the n' by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

Example, Ordering Configuration

To order a 100 MHz, 250 MS/s CombiScope in rack mountable configuration, with GPIB/IEEE-488 interface installed, and U.S. line cord select:

	Model
Basic Oscilloscope	PM 3377
GPIB/IEEE-488	/403
Complete Model Number	PM 3377/403

Accessories (Also see end of Section 2)

Passive Probes

PM 9011/001 Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 100 MHz (in 10:1 mode), 10 MHz (in 1:1 mode)
PM 9021/001 Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 200 MHz (in 10:1 mode), 10 MHz (in 1:1 mode)
PM 9001/001 Modular 1:1 Probe, 1.5m (5 ft) Cable
PM 9001/091 Modular 1:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 9001/201 Modular 1:1 Probe, 2.5m (8 ft) Cable
PM 9001/291 Modular 1:1 Probe, 2.5m (8 ft) Cable, Auto Range Indicator and Command Button
PM 8926/591 10:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator
PM 9100/001 Modular 100:1 Probe, 1.5m (5 ft) Cabl
PM 9100/091 Modular 100:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 8918/002 Set of two 10:1 Probes, one Grey, one Red, 1.5m (5 ft)
PM 8918/202 Set of two 10:1 Probes, one Grey, one Red, 2.5m (8 ft)

Active Probes

PM 8940/09n High Voltage Isolation Amplifier with Auto Range
PM 8943A/00n 650 MHz FET Probe
PM 9355/09n 70 MHz AC Current Probe with Auto Range

The n' indicates the required line cord. To select your line cord substitute the n' by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

PM 3375, PM 3355, PM 3365A, & PM 3350A

Other Accessories

PM 8902A/001 12V DC Power Inverter
PM 8903A/00n Battery Pack, Charger, Inverter and Carrying Case
PM 8917/00n NTSC and PAL Video Sync Separator and Line Selector
PM 8957A/00n Retrofittable GPIB/IEEE-488 Interface
PM 8958A/001 Retrofittable RS-232C Interface
PM 8988 Protective Front Panel Cover (included in PM 3365 & PM 3375 as standard accessory)
PM 8989/031 Traveller Carrying Case
PM 8991/041 Oscilloscope Cart
PM 8992/80 Accessory Pouch
PM 9051 BNC to 4 mm Banana Adapter
PM 9076/01 DIN - 4 mm Banana Analog Plot Out Cable
PM 9076/02 DIN - Amphenol Analog Plot Out Cable
PM 9381 Oscilloscope Camera System
PM 2255/001 Series Instrument Driver Software
PM 2270/003 DSO COM, RS-232 Waveform Transfer Software
PM 2273/001 AnyWave Waveform, Template and Pass/Fail Testing Software
PM 9372/002 Telephone Communication Software for Service Support Applications
TC100 Instrument Cart
TC 100-01 Optional Power Strip for TC100 (U.S. only)
TC 100-02 Optional Drawer for TC100
TC 100-03 Optional CPU Bracket for TC100
TC 100-04 Optional Power Strip, Drawer, and CPU Bracket for TC100 (U.S. only)

The n' indicates the required line cord. To select your line cord substitute the n' by:

1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

Manuals*

PM 3350 Operator*
PM 3350A/52A/55/57 Reference*
PM 3350A/52A/55/57 Service
PM 3350A-77 Operator Card*
PM 3365/3367 Operator Guide*
PM 3365A/67A/75/77 Reference*
PM 3365A/67A/75/77 Service

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

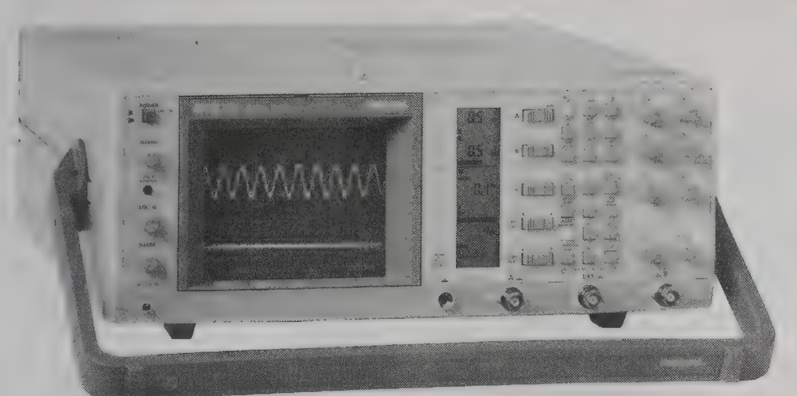
Factory Warranty

Three-year product warranty. Five-year CRT warranty.

PM 3335

GPIB
IEEE-488

RS-232



PM 3335

PM 3335 CombiScope

- Analog oscilloscope plus full function Digital Storage Oscilloscope
- 20 MS/s synchronous real time sample rate on each channel
- 60 MHz analog bandwidth
- Deep 8K bytes x 8-bit waveform acquisition memory even at max sample rate
- Second reference memory for comparison of waveforms
- AUTOSET for instant on-screen trace display
- Standard cursors for many on-screen measurements
- GPIB/IEEE-488 and RS-232C interface options

Two Scopes in One

The PM 3335 sets a standard in performance and economy. This instrument is two professional scopes in one: it operates as a real time 60 MHz analog oscilloscope and at the touch of a button, becomes a full function digital oscilloscope for advanced applications. Now, you have the power for digital capture and analysis of elusive single shots with a full 20 MS/s sample rate on each channel simultaneously. Unlike some scopes in this class, the full sample rate is maintained for all channel combinations, giving a single event resolution of 50 ns for both channels. Repetitive signal analysis is also possible up to 60 MHz in analog oscilloscope mode. A x10 expansion allows 5 ns sweep speeds for detailed viewing and furthermore, with the 100 MHz trigger bandwidth, you have a higher trigger sensitivity over the full range.

Extensive Memory Capability

In a DSO, it is vital that the memory be large enough to capture all the data in the intended areas of use. The PM 3335 will be used in automotive, medical, mechanical, video and general electronics industries, as well as in education and training. Here, scopes must capture typical waveforms over a full cycle and have an adequate sample resolution to show fine details within a cycle. Typical examples here are in video waveforms or engine injection cycles. With its deep 8K bytes x 8-bit acquisition memory and 20 MS/s sample rate, the PM 3335 fully meets this requirement – indeed no other instrument in this price class has such a large memory.

For waveform comparison, a second reference memory is available. The full 8K bytes x 8-bit memory allows storage and display of up to 2 reference waveforms. Together with the 2 live waveforms from the acquisition memory, a total of 4 waveforms can be displayed.

Measurement Cursors as Standard

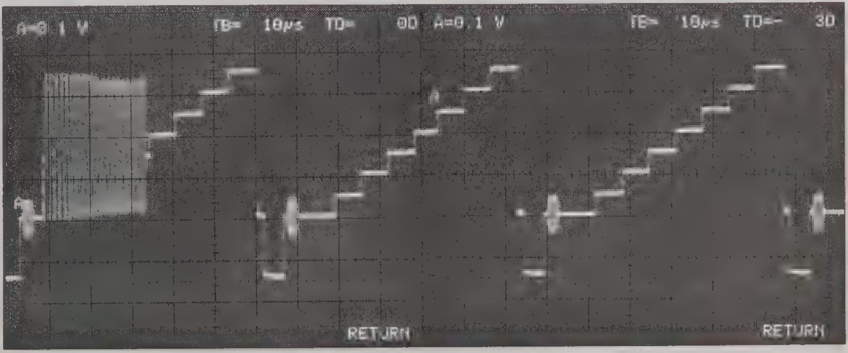
Independent voltage and time cursors make signal parameter extraction both accurate and fast. Along with measurement of voltage and time differences (dV, dt), the measurement functions include selection of ratio, phase and track. To aid the user further, a simple frequency calculation is made by 1/dt.

Positioning cursors on the easily identified 10% and 90% of peak-to-peak value gives a rise/fall time readout. Cursors are particularly valuable in dc measurements where any point on the captured waveform can be measured to reference ground. This further extends use of the cursors so that readouts can show not only difference in results on a single trace, but also from trace to trace.

Powerful Triggering

The PM 3335's deep memory can also be used to show extensive pretrigger information. Unlike a conventional scope, a DSO can pretrigger, i.e. capture and display events prior to a trigger. A DSO continuously acquires data until stopped by detection of a valid trigger signal, rather than starting the sweep on detection of the trigger, like an analog oscilloscope. Thus all samples captured by the DSO are effectively in "negative time" and contain pretrigger waveform information.

This function is very useful in showing, for example, the complete leading edge of a pulse waveform for rise/fall time measurement (compared to an analog scope that can only show the edge form from the trigger moment on). Another example is to examine preshoot signals or transients leading up to the trigger edge. In the PM 3335, up to 20 divisions of pretrigger information can be captured and analyzed.



The deep 8k memory gives you double-length viewing for single-channel acquisition, even at the maximum sample rate. Now you can see more of the "picture" with the PM 3335.

PM 3335

Two Interfaces in One

The PM 3335 has communication facilities normally only expected in instruments in much higher price ranges. Its optional interface has both RS-232C and GPIB/IEEE-488* capability. Either can control instrument set-up and transfer waveform data in remote control applications. When combined with the increasing range of programming and control packages, the PM 3335 is ideal for automatic signal capture and analysis.

Advanced Plot and Print Capability

The PM 3335 has so many functions not usually found in competitive instruments, it should not come as a surprise that it has extensive plot and print capabilities. The plot function outputs screen copies to industry standard plotters and printers via the optional interface card. Plot language is HP GL. Screen copies can also be sent to Epson compatible printers or compatibles over both interfaces.

Simple to Operate

While the PM 3335 offers capabilities never before seen in a cost-effective scope, this is not at the expense of ease of use. Ergonomics was a vital element in design of the instrument.

- Direct parameter readout of the present set-up on an LCD panel for at-a-glance checking of information, avoiding the need to look at control settings on a crowded text plate.
- Fast action up/down controls give finger tip setting of range values quickly and securely. Reliability is guaranteed by cold switching through microprocessor control. All rocker keys are located directly next to the clear LCD for readout and immediate confirmation of set-up.
- Front panel layout is logical, with similar functions grouped together for instant recognition. All controls that relate to variable settings such as Y-pos or VAR are located on the right hand side of the front panel resulting in a clear layout.
- Softkeys are positioned directly under the CRT display, mounted flush in the screen bezel. Softlabels appear on the screen just above these keys with a readily understandable menu sequence and selection. After acquisition of the signal, attention is focused on the display, avoiding mistakes that can occur when selections are out of the field of vision.

The result is an instrument that is readily understood and easy to use, while offering a versatile capability for fast problem solving.

Autoranging, Autoscaling and AUTOSET

Another first for the PM 3335 is its full function AUTOSET. A single push of the AUTOSET button and any signal is automatically scanned and an optimum display of the trace is provided. It is not a factory preset, but is a full autoranging of time base and amplitude parameters depending on the incoming input signal. In addition, each channel is searched for a signal and if no signals are present, that channel is not displayed to avoid confusing information. Moreover, the AUTOSET selects the best trigger source for maximum trace stability. No other manufacturer gives you all these facilities for such a low price.

Modular Construction

The PM 3335 modular design and construction gives unparalleled serviceability. Swing up PCBs allow easy access to all circuits, for quick and efficient repair and service. Built in test routines with on screen prompts guide the service engineer quickly to the problem; and a quick check and adjust facility provides verification of the correct functioning of the instrument for reliable measurement results.

The modular construction also allows thorough testing of each module in production, before being built into the complete instrument, after which final functional tests and adjustments are made. This results in reliable instruments that give trouble free operation throughout their life.

Specifications

Technical Specifications

AUTOSET: Automatically selects proper channel(s), trigger and time base mode, and scales the display for proper amplitude and timing. Autoset operates in the analog, as well as the digital storage modes.

Analog Mode

Vertical

Analog Display Modes: Ch A, Ch B, -Ch B, Ch A + Ch B, Ch A - Ch B (ALTernate or CHOPped)
Frequency Response: DC to >60 MHz, -3 dB (20 mV/div to 10 V/div); dc to >35 MHz, -3 dB (2 mV/div to 10 mV/div); ac, lower 3 dB point is <10 Hz
Rise Time: <5.8 ns (20 mV/div to 10 V/div); <10 ns (2 mV/div to 10 mV/div)
Deflection Coefficient: 2 mV/div to 10 V/div in 1, 2, 5 sequence
Error Limit: ±3%, continuous control between steps with ">" flashing on LCD panel as warning symbol for uncalibrated setting
Input Impedance: 1 MΩ ±2%; 20 pF ±2 pF
Maximum Input Voltage: 400V (dc + ac peak)
Dynamic Range: >24 div at 10 MHz, >8 div at 60 MHz
CMRR: 100:1 at 1 MHz

Horizontal

Display Modes: Time base, or XY displays using Ch A and/or Ch B (vertical) and Ch A, Ch B or Ext (horizontal).
Time Base: 0.5 s/div to 50 ns/div in 1, 2, 5 sequence
Expansion: x10, fastest sweep speed 5 ns/div
Error Limit: ±3%; ±4% in x10; continuous control between steps with ">" flashing on LCD panel as warning symbol for uncalibrated setting

Triggering

Trigger Modes: Auto (free run), non-auto triggered, single sweep
Trigger Sources: Ch A, Ch B, composite (Ch A, Ch B), Ext (dc or ac); line LCD indicates not-triggered, triggered or armed status
Trigger Coupling: Auto peak-to-peak (p-p), dc, TVF, TVL, LF Reject, HF Reject

Trigger Sensitivity

	Internal	External
10 MHz	0.5 div	50 mV
60 MHz	1.0 div	150 mV
100 MHz	2.0 div	500 mV
TVF/TVL	0.7 div sync	70 mV sync
Level Range	±8 div	±800 mV

Slope, positive or negative; TVF or TVL, positive or negative

X-Deflection

Deflection Coefficient: Via Ch A or Ch B, 2 mV/div to 10 V/div; via Ext input, 100 mV/div
Frequency Response: DC to 2 MHz
Error Limit: ±5%
Phase Shift: <3° (at 100 kHz)
Ext Input Impedance: 1 MΩ ±2%; 20 pF ±2 pF
Maximum Input Voltage: 400V (dc + ac peak)

Digital Mode

All specifications as analog part unless otherwise stated

Vertical

Resolution: 8 bit
Display Modes: Ch A, Ch B, -Ch B
Frequency Response: DC to >5 MHz, -3 dB (2 mV/div to 10 V/div)

Horizontal

Display Modes: Recurrent, single shot, multiple shot (up to 2)

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3335

Time Base
Recurrent, Single, Multiple Shot: 50 s/div to 10 µs/div
Timing Accuracy: ±0.1%
Display Expansion: x1 to x32

Horizontal Resolution
Single Channel: 8192 samples/channel
Dual Channel: 4096 samples/channel

Signal Acquisition
Maximum Sample Rate: 20 MS/s, simultaneously for both channels
Trigger Delay: 20 divisions of pretrigger
Display Expansion: x1 to x32 horizontal

Memory
Storage Registers: 2
Number of Traces Stored in Each Register: Up to 2
Depth of Acquisition Memory: 8192 words
Depth of Reference Memory: 8192 words
Vertical Memory Resolution: 8 bit
Display Modes: Ch A, Ch B, Register A, Register B in any combination

Cursors
Horizontal Resolution: (all display modes) 1:1000 over 10 divisions
Vertical Resolution: 1:200 over 8 divisions
Read Out Resolution: 3 digits amplitude and time
Calculation Functions: dV, dt, 1/dt, ratio, phase

Interfacing
Interface Option PM 8959/001 or Option /403: Contains both IEEE-488 and RS-232C capability

Programming Functions
Remote Control: The IEEE-488 and RS-232C interface provides full control over all switchable functions of either instrument. This includes acquisition and measurement functions. Waveform data can be transferred from scope to controller and back, and measurement results and instrument settings can be read by the controller as well.

IEEE-488
Bus Driver: E2 (three state)
Function Repertoire: SH1, AH1, T5, L3, SR1, RL2, PP0, DT1, DC1, C0

RS-232C
Handshake: Software XON/XOFF, hardware DSR/DTR and CTS/DTR
Baud Rate: Transmit and receive 75 to 4800 bits/sec
Stop Bits: 1 or 2
Parity: Odd, even or none
Character Length: 7 or 8 bits

Interface Option PM 8961/001 or Opt /503

RS-232C (Data Dump only)
Handshake: Software XON/XOFF, hardware DSR/DRT and CT5/DTR
Baud Rate: Transmit 75 to 4800 bits/sec
Stop Bits: 1 or 2
Parity: Odd, even or none
Character Length: 7 or 8 bits

Digital Plot (Option /403 or /503)

Language: HP GL or Philips GL
Plotter Select: Philips PM 8153/1, PM 8153/6, PM 8154, PM 8155, HP 7450, HP 7475A
Pen Select: Pen 1 for Ch A; Pen 2 for Ch B; Pen 3 for Register Ch A; Pen 4 for Register Ch B; Pen 5 for graticule and alphanumerics
Plot Area: Softkey selectable
Dot Matrix Printer Screen Dump: Compatible with Epson FX Series and HP Thinkjet® graphics protocol or compatibles
Drawing Area: 10 cm x 10 cm

General Specifications

Display

Screen: CRT with 8 x 10 cm viewing area; P31 phosphor, 16 kV acceleration voltage. Softkey display area on CRT for selection of menu choices.
Graticule: Parallax-free with continuously variable illumination
LCD Display: Separate constantly backlit LCD for display of status information, settings, etc

Power Supply

Line Voltage Range: 100V to 240V ac ±10%
Line Frequencies: 50 Hz to 400 Hz ±10%
Power Consumption: 70W

Environmental Data

Temperature
Rated Range of Use: +10°C to +40°C
Operating Range: 0°C to +50°C
Storage: -40°C to +75°C

Altitude
Operating: 4,500m (15,000 ft)
Transport: 12,000m (40,000 ft)
EMI: Meets requirements of MIL-STD-461 Class B, VDE 6871 and VDE 0875 Grenzwertklasse B
Safety: Meets requirements of IEC 348 Class 1, VDE 0411, UL 1244. CSA Certified (CSA556 B)
Shock: Operating and non-operating: Max acceleration 30g, ½ sine, 11 ms duration, 6 shocks on each axis, 3 shocks on each face giving a total of 18 shocks
Bench Handling: MIL-STD-810 method 516, procedure V

Mechanical Data

Width: 387 mm (15.2 in) incl handle, 350 mm (13.8 in) excl handle
Length: 531 mm (20.9 in) incl handle and knobs; 518 mm (20.4 in) incl handle, excl knobs; 456 mm (17.9 in) excl handle, incl knobs; 434 mm (17.1 in) excl handle and knobs
Height: 146.5 mm (5.8 in) incl feet, 134.5 mm (5.3 in) excl feet
Weight: Approx 9.5 kg (20.9 lb) excl accessories

Ordering Information

Models

PM 3335 60 MHz, 20 MS/s, CombiScope
PM 3337 Same, with Rack Mount

Included with Instrument

Three-year product warranty, parts and labor, five-year CRT warranty, line cord, two 100 MHz 10:1 probes, model PM 8926/591 or equivalent, with 1.5m (5 ft) cable and scale factor readout, blue CRT contrast filter, operator and reference manual, (a service manual is available upon return of reply card included with each instrument), and Certificate of Calibration Practices.

Optional Configurations

When ordering, select basic "PM" model number, and add the configuration option number listed below as a suffix.

/00n Standard Version
/40n GPIB IEEE-488/RS-232C Interface
/50n Dump-only RS-232C Interface

All options are factory installed only.

The n' indicates the required line cord. To select your line cord substitute the n' by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

Example, Ordering Configuration

To order a 60 MHz, 20 MS/s CombiScope in rack mountable configuration, with GPIB/IEEE-488 and RS-232C combined interface installed, and U.S. line cord select:

	Model
Basic Oscilloscope	PM 3337
GPIB/IEEE-488 & RS-232C	/403
Complete Model Number	PM 3377/403

Accessories (Also see end of Section 2)
Passive Probes
PM 9011/001 Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 100 MHz (in 10:1 mode), 10 MHz (in 1:1 mode)
PM 9021/001 Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 200 MHz (in 10:1 mode), 10 MHz (in 1:1 mode)
PM 9001/001 Modular 1:1 Probe, 1.5m (5 ft) Cable
PM 9001/091 Modular 1:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 9001/201 Modular 1:1 Probe, 2.5m (8 ft) Cable
PM 9001/291 Modular 1:1 Probe, 2.5m (8 ft) Cable, Auto Range Indicator and Command Button
PM 8926/591 10:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator

PM 3335

PM 9100/001 Modular 100:1 Probe, 1.5m (5 ft) Cable
PM 9100/091 Modular 100:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 8918/002 Set of two 10:1 Probes, one Grey, one Red, 1.5m (5 ft)
PM 8918/202 Set of two 10:1 Probes, one Grey, one Red, 2.5m (8 ft)

Active Probes

PM 8940/09n High Voltage Isolation Amplifier with Auto Range
PM 8943A/00n 650 MHz FET Probe
PM 9355/09n 70 MHz AC Current Probe with Auto Range

Other Accessories

PM 8902A/001 12V DC Power Inverter
PM 8903A/00n Battery Pack, Charger, Inverter and Carrying Case
PM 8917/00n NTSC and PAL Video Sync Separator and Line Selector
PM 8957A/00n Retrofittable GPIB/IEEE-488 Interface
PM 8958/001 Retrofittable RS-232C Interface
PM 8988 Protective Front Panel Cover
PM 8989/031 Traveller Carrying Case
PM 8991/041 Oscilloscope Cart
PM 8992/80 Accessory Pouch
PM 9051 BNC to 4 mm Banana Adapter
PM 9076/01 DIN - 4 mm Banana Analog Plot Out Cable
PM 9076/02 DIN - Amphenol Analog Plot Out Cable
PM 9381 Oscilloscope Camera System
PM 2255/001 Series Instrument Driver Software
PM 2270/003 DSO COM, RS-232 Waveform Transfer Software
TC100 Instrument Cart
TC 100-01 Optional Power Strip for TC100 (U.S. only)
TC 100-02 Optional Drawer for TC100
TC 100-03 Optional CPU Bracket for TC100
TC 100-04 Optional Power Strip, Drawer, and CPU Bracket for TC100 (U.S. only)

The n' indicates the required line cord. To select your line cord substitute the n' by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

Manuals

PM 3335/37 Operator*
PM 3335/37 Reference*
PM 3335/37 Service*

**No charge with purchase of unit*

Customer Support Services

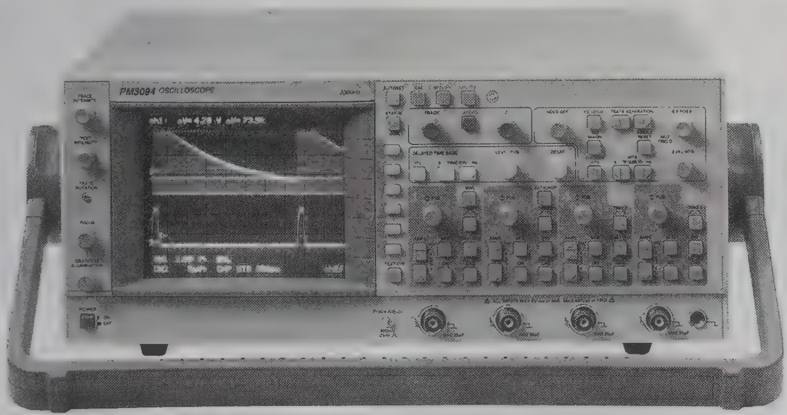
Also see Section 20.

Factory Warranty

Three-year product warranty. Five-year CRT warranty.

PM 3082, PM 3084, PM 3092 & PM 3094

SCPI
GPIB
IEEE-488
RS-232



PM 3094

PM 3082/84 100 MHz & PM 3092/94 200 MHz Analog Scopes

- Choice of 100 MHz or 200 MHz bandwidths
- True 4-channel models have 4 complete and independent signal inputs
- Exceptional 1% voltage and timing accuracy
- AUTOSET for instant, optimized display
- Delayed Time Base with full trigger capabilities
- Advanced trigger facilities include HDTV and on-screen trigger level display
- Powerful cursor measurements with direct numeric readout
- Automatic voltmeter measurements
- Probe recognition, automatic or manually selectable
- Standard RS232-C interface, GPIB/IEEE-488.2 optional, full remote capability
- Calibration intervals up to 2 years

The New 100 MHz and 200 MHz 4-Channel Analog Standard

These new analog scopes set the new 100 MHz and 200 MHz standard, giving you maximum functionality to handle the widest possible range of signal measurements. In combination with their competitive price level, that means the greatest possible value for money. These scopes will meet all your requirements – both today and tomorrow.

Full 4-Channel Capabilities

The new range of true 4-channel oscilloscopes give you significant advantages over conventional 2-channel instruments. The 4 separate inputs allow fully independent full-range sensitivity setting on all channels - an important benefit in many situations where you need to examine the relationships between more than 2 signals.

These advanced 4-channel capabilities are ideal for situations like 3-phase measurements, checking RGB video signals, circuits with multiple digital signals, or mixed digital/analog circuits. Another powerful function is differential measurements - use the 4 inputs to display 2 difference signals, both of which can be examined and measured simultaneously.

Choice of 2 + 2 Channel Models

Next to the advanced 4-channel models, this new range of analog scopes also includes two very competitively priced models with 2 + 2 channel inputs and a choice of 100 MHz and 200 MHz bandwidths. These two models are ideal general-purpose oscilloscopes for use in environments like service and training, where top value is an essential requirement.

Simple, Familiar Operation

For an instant, optimized display of any input signal, all you have to do is press the green AUTOSET button. You can even customize the AUTOSET function using the set-up menu to meet your own preferences.

Next to the traces, the screen display also shows you channel identifiers and ground level indicators, plus numeric readouts of exact measured values and instrument settings. This means that all the information you need is clearly displayed on-screen, making these scopes even easier and more convenient to use.

Making operation even easier and further reducing the chance of errors is a clear, logical front-panel layout. There's a single button for every major function, giving you direct access to the mode you want. And to control the 4 input channels, you'll find 4 corresponding front-panel sections - each with its own attenuation and time base settings*. Measurement set-up is simplified by automatic probe recognition. So all you need to do is connect your test signals, press AUTOSET and take the measurement you want. Operation and settings are computer-controlled, reducing the chance of error and maximizing speed and convenience.

Constant High Accuracy – Always Calibrated

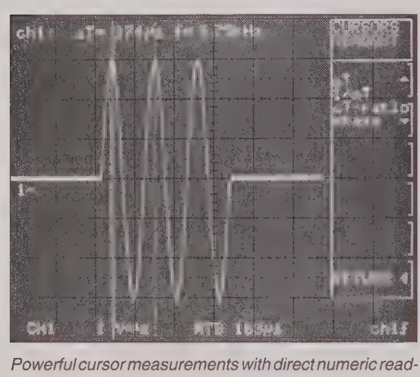
Ensuring optimum accuracy in all operating environments, these new analog scopes have a built-in AUTOCAL function. Just push a button, and all basic instrument settings are fine-tuned to

** 4 separate inputs on full 4-channel models only.*

	PM 3082	PM 3084	PM 3092	PM 3094
Bandwidth	100 MHz	100 MHz	200 MHz	200 MHz
Channels	4 (2+2)	4	4 (2+2)	4
Max. sensitivity	2 mV/div.			
Max. sweep speed (MTB and DTB)	5 ns/div.		2 ns/div.	
Input coupling	1 MΩ//25 pF		50Ω and 1 MΩ//25 pF	
Accuracy	1% voltage and timing			
Acceleration voltage	16,5 KV			
Bandwidth limiter	20 MHz			
Front-panel storage	10 set-ups with battery back-up			

PM 3082, PM 3084, PM 3092 & PM 3094

their specified values. Which means your measurements are sure to be within the high ±1% accuracy for both time and amplitude. AUTOCAL ensures that accuracy is always maintained, by compensating for changes in ambient conditions like temperature and humidity.



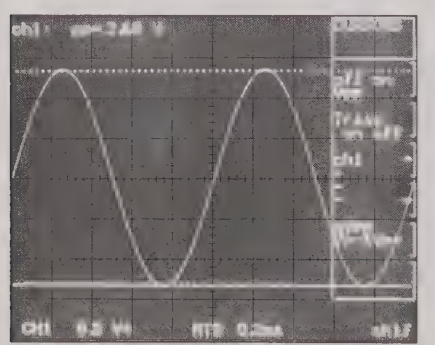
Powerful cursor measurements with direct numeric read-out and unprecedented 1% accuracy.

These new analog scopes are always calibrated, even in the variable range between the normal 1, 2, 5 amplitude or time settings. This AUTOCAL function means that you can now set up the scope for the best visual display, without compromising on measurement accuracy. Helping you to save time, increasing the accuracy of your results, and avoiding mistakes.

Fast Cursor and Voltmeter Measurements

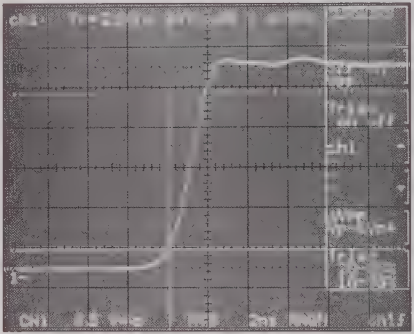
As far as measurements are concerned, these new scopes will give you the results you want - fast. A wide range of cursor measurements give you instant voltage and timing data through a direct on-screen read-out. Available measurement modes include dt, frequency, dt ratio, phase, dV, Vabs and dV ratio.

Making your measurements fast and simple, automatic cursor positioning helps you instantly to locate voltage min./max. values, allowing fully automated Vp-p measurements.



Automatic cursor positioning at min/max voltage values allowing fully automated Vp-p measurements.

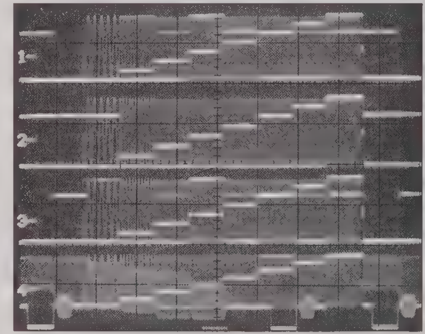
Rise time measurements, too, are made instantly thanks to automatic cursor positioning at either the 10/90% or 20/80% levels. And as these measurements can even be made with variable amplitude or time settings, you can always measure to the highest possible accuracy.



Automatic positioning of voltage cursor for rise time measurements selectable at 10-90% or 20-8% levels.

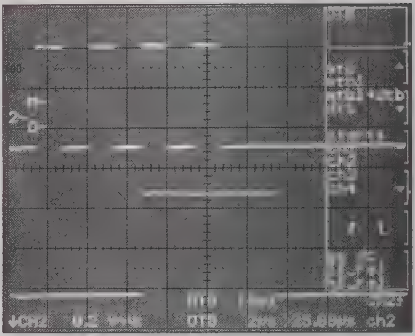
Maximum Signal Detail

The bright, high-resolution CRT gives you a crisp display that's always easy to read. The advanced Philips CRT design, together with the highly accurate input circuitry, ensures high sensitivity, with a clear, low-noise image.



High brightness CRT shows complete signal detail.

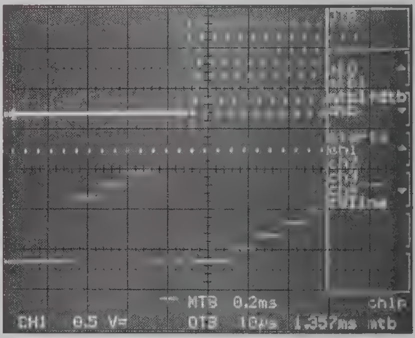
To get the maximum information out of expanded signal details of interest, you'll find a Delayed Time Base facility, with a fast sweep speed of up to 2 ns/div., And like all Fluke oscilloscopes with delayed sweep, these new instruments have independent trigger settings for both Main and Delayed Time Bases.



Delayed time base, 2 ns/div, with full trigger capabilities to zoom in on a signal details

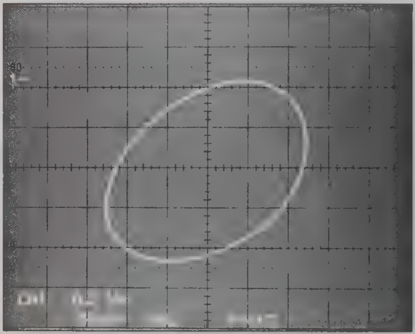
Versatile Triggering Including HDTV

Versatile triggering is a strong point of these new oscilloscopes. The powerful triggering facilities include on-screen level display, HF/LF reject filters, TV frame and line triggering. You can widen the trigger gap to ensure stable triggering, even on noisy signals.



Super stable video triggering on both main and delayed sweep enable detailed examination of video signals.

You can also trigger on the 3-level HDTV sync., which prepares these oscilloscopes for future HDTV applications.



HDTV 3 level sync.

PM 3082, PM 3084, PM 3092 & PM 3094

Compact, Portable and Reliable

High component integration and SMD technology make these oscilloscopes compact and lightweight. At the same time, maximizing reliability over a long, trouble-free lifetime. In addition, computer-controlled analog circuits with cold switching and digital potentiometers eliminate wear and drift and resist contamination.

Quality That's Designed-In and Built-In

Every Fluke oscilloscope has quality that's designed-in and built-in right from the start. That means not only reliability and durability, but also an excellent EMI and environmental specification, meeting virtually all requirements in these areas. Our advanced, highly automated manufacturing facilities create products that give you dependable performance, while ISO 9001 certification provides a guarantee of consistent high quality.

Contributing further to the exceptionally low cost of ownership, these new scopes have closed-case calibration facilities and extended intervals between calibrations, saving you external cal lab costs. Calibration intervals can be as long as two years, if 2% accuracy is sufficient. These instruments have a sturdy, rugged construction that allows them to withstand tough everyday operating conditions in service workshop, development lab or production line environments. Like all Fluke oscilloscopes, the new analog scopes meet all major certification requirements including CSA 665B.

Specifications

Technical Specifications

AUTOSET: Selects proper channel-, time base- and trigger settings. Function can be customized by the user.
AUTOCAL: Automatic fine adjustment for enhanced accuracy to get optimal performance even under extreme environmental conditions.

Vertical Deflection

Input Channels: Four fully attenuated channels or Four (2+2) channels (PM 3092/PM 3082)
On Screen Indicators: Channel identifiers with ground level indication
Display Modes: CH1, (-)CH2, CH3, (-)CH4, Add: CH1 & (-)CH2, CH3 & (-)CH4 In ALTernation or CHOPped mode
Frequency Response: DC to >200 MHz -3 dB or DC to >100 MHz -3 dB (PM 3084/PM 3082)
In AC Mode: Lower -3 dB point: <10 Hz
Bandwidth Limiter: 20 MHz - 3 dB
Rise Time: <1.75 ns (calculated: 0.35/BW) or <3.50 ns (PM 3084/PM 3082)
Deflection Coefficient: 2 mV/div to 5 V/div in a 1-2-5 sequence or continuously calibrated control: 2 mV/div to 12.5 V/div
Channel 3 and 4: 0.1 V/div and 0.5 V/div (PM 3092/PM 3082)
Error Limit: 1.3% (measured over central 6 divisions)
Input Impedance: 1 MΩ ±1%// 25 pf ±2 pf and 50Ω ±1% (PM 3094 and CH1 & 2 of PM 3092)
Max. Rated Input Voltage: In 1 MΩ position: 400V (dc + ac peak; <10 kHz); In 50 Ω position: 5V rms; 50V ac-peak (maximum of 50 mJ during any 100 ms interval)
Dynamic Range: 24 div at 50 MHz (25 MHz PM 3082/PM 3084); 8 div at full bandwidth (100 or 200 MHz)
CMRR: 100:1 at 1 MHz, 25:1 at 50 MHz
Channel Isolation: 50:1 at full bandwidth (100 or 200 MHz)

Horizontal

Display Modes: Main TB and/or Delayed TB, X-deflection

Main Time Base

Time Coefficients: 0.5 s/div to 20 ns/div in a 1-2-5 sequence or continuously calibrated control: 1.25 s/div to 20 ns/div. For PM 3084 and PM 3082 the fastest time base setting is 50 ns/div.
Fastest Sweep: 2 ns/div (magn 10x) or 5 ns/div (PM 3084/PM 3082)
Error Limit (magn 1x): ± (1.3% of reading + 0.5% of 8 divisions)
Hold-off: Up to 20 div of MTB setting (max 2 sec.)

Delayed Time Base

Time Coefficients: 0.5 ns/div to 20 ns/div in a 1-2-5 sequence or 0.5 ms/div to 50 ns/div (PM 3084/PM 3082)
Fastest Sweep: 2 ns/div (magn 10x) or 5 ns/div (PM 3084/PM 3082)
Error Limit (magn 1x): ± (1.3% of reading + 0.5% of 8 divisions)
Trace Separation: ±>4 div

Delay Time Multiplier

Resolution: 1:40,000
Error Limit (magn 1x): ± (0.8% of reading + 0.3% of 8 divisions + 4 ns)
Jitter: 1:25,000

Triggering (MTB & DTB)

Trigger Modes: Auto free run, Triggered, Single; Edge triggering, TV triggering.

Edge Triggering

MTB Trigger Source: CH1 to CH4, Composite, Line (mains)
DTB Trigger Source: Starts, CH1 to CH4
Slope: Positive (+) or negative (-)
Coupling: DC, AC (10 Hz), LF-rej (30 kHz), HF-rej (30 kHz)
Level Range: ±8 div or level within signal peak-peak range
Level Indication: On screen level indicators and numeric readout

Trigger Sensitivity
PM 3094/PM 3092: 0.5 div up to 100 MHz, 1.0 div up to 200 MHz, 2.0 div up to 300 MHz
PM 3084/PM 3082: 0.5 div up to 50 MHz, 1.0 div up to 100 MHz, 2.0 div up to 200 MHz

TV Triggering

Video Standard: HDTV, NTSC, PAL, SECAM;
MTB Trigger Source: CH1 to CH4; Field 1, Field 2, TV-line
DTB Trigger Source: Starts, CH1 to CH4 edge, TV-line
Signal Polarity: Positive or negative
Sensitivity: 0.7 div (sync. pulse)

X-Deflection

Deflection Source: CH1 to CH4, Line (mains)
Deflection Coefficient: See vertical deflection
Dynamic Range: 20 div up to 100 kHz; >10 div up to 2 MHz
Frequency Response: 2 MHz -3 dB
Error Limit: 5% measured over central 6 divisions
Phase Shift: <3° up to 100 kHz

Cursor Measurements

Cursor Modes: Manual positioning: Horizontal, Vertical, Both
Auto Positioning: Vp-p or 10-90% or 20-80%
Readout (mode of dependent): Vertical: dV, V1&V2 to GND, Ratio
Horizontal: dT, 1/dT (in Hz), Ratio, Phase; Auto positioning: Vpp, Vp+&Vp- to GND, Vdc, and Trice
Accuracy (magn 1x): 1% of full scale. Within the central 8 horizontal and 6 vertical division for manual cursor positioning.

Interfaces

RS-232C: 9 pin D connector
Handshake: DSR/DTR, CTS/RTS and Xon/Xoff
Baudrate: 75 to 38400
Format: 1 stopbit; 7 or 8 databits; odd/even/no parity
Protocol: CPL = Compact Programming Language = reduced set of powerful instructions for full remote control
GPIB/IEEE-488.2*: Factory installed option
Protocol: SCPI = Standard Commands for Programmable Instruments = IEEE standardized protocol

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**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3082, PM 3084, PM 3092 & PM 3094

General Specifications

Miscellaneous

DISPLAY: 8 X 10 cm viewing area, 16.5 kV acceleration voltage. Parallax free graticule with continuously variable illumination. On screen readout.
Setting Memory: 10 instruments setups, non volatile
Calibration Output: 2 kHz square, 600 mV peak-peak
Z-Modulation Input: BNC, 10 kΩ >2.4V = blanked, <0.5V = unblanked
Time Between Calibration: 2000h or 1 year (4000h or 2 years if error limits are doubled)

Power Supply

Line Voltage: 100V to 240V (+10%)
Line Frequency: 50 HZ to 400 Hz (±10%)
Power Consumption: 60W (80W with all options installed)

Environmental Data

Meets Requirements of: MIL-T-28800D Type III, Class 3, Style D, Color R
Temperature: 0°C to +50°C (operating), +5°C to +40 °C (use), -40°C to +70°C (storage)
Humidity: 95% (storage)
Altitude: 4.6 km (operating), 12 km (transport)
Vibration: Frequency 5 HZ to 55 Hz, maximum acceleration at 55 Hz 30 M/s^2
Shock: 6 shocks along each axis, half sine wave, 6 to 9 msec, peak acceleration 400 m/s^2
Bench Handling: Meets MIL-STD-810, method 516, procedure V
Safety: Meets requirements of IEC 348 Class I, UL 1244, VDE 0411, CSA C22.2 No 231 (approval applied for)
EMI: VDE 0871 Grenzwertklasse B; MIL-STD-461C: CEO1 Part 2 (narrow band), CEO3 Part 4, CS01 Part 2, CS06 Part 5 (300V max.), RE01 Part 5 and 6, RE02 Part 2 (1 GHz max.)

Mechanical Data

Fan: Proportionally regulated forced air
Size: 139 mm H 341 mm W x 481 mm L (5.5 in H x 13.4 in W x 18.9 in L) (excluding handle and feet); 147 mm H 391 mm W x 551 mm L (5.8 in H x 15.4 in W x 21.7 in L) (including handle and feet)
Weight: 8.5 kg (20 lb)

Auxiliary Output/External Trigger Option

Factory Installed Option Includes:
Y-Out: BNC, 50Ω, 10 mV/div in 50Ω, 20 mV/div in 1 MΩ
MTB-Gate-Out: BNC, 1 kΩ, TTL compatible levels
DTB-Gate-Out: BNC, 1 kΩ, TTL compatible levels

External Trigger Input (with the following specs)
MTB Trigger Source: CH1 to 4, composite, external
Impedance: 1 MΩ
Coupling: AC, DC, LF-rej (30 kHz), HF-rej (30 kHz)
Slope: Positive (+) or negative (-)
Trigger Gap: 80 mV; trigger gap can be doubled for triggering on noisy signals
Bandwidth: Sensitivity at 10 MHz: <80 mV
Input Amplifier: Dynamic range of the dc coupled input amplifier: -2.5V to +2.5V (on BNC connector); -25V to +25V (on probe tip of 1:10 probe)
Maximum Input Voltage: 400V peak

Ordering Information

Models

PM 3082 100 MHz Analog Oscilloscope with 2 + 2 Channels and Delayed Time Base
PM 3084 100 MHz Full 4 Channel Analog Oscilloscope with Delayed Time Base
PM 3092 200 MHz Analog Oscilloscope with 2 + 2 Channels and Delayed Time Base
PM 3094 200 MHz Full 4 Channel Analog Oscilloscope with Delayed Time Base

Included with Instrument

Three-year product warranty, parts and labor, five-year CRT warranty, two wide bandwidth 10:1 probes, with 1.5m (5 ft) cable and scale factor readout, blue CRT contrast filter, front cover, operator and reference manual (IEEE-488 versions include a programming manual) (a service manual is available upon return of reply card included with each instrument), and Certificate of Calibration Practices.

Optional Configurations

When ordering, select basic 'PM' model number, and add the configuration option number listed below as a suffix.

/00n Standard Version
/40n GPIB/IEEE-488 Interface
/73n Ch 1 Signal Output, MTB Sweep and MTB + DTB Gate Outputs
/93n GPIB/IEEE-488 Interface with Ch 1 Signal Output, MTB Sweep and MTB + DTB Gate Outputs

All options are factory installed only.

The n' indicates the required line cord. To select your line cord substitute the n' by:

1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

Example, Ordering Configuration

To order a 200 MHz, full four channel Analog Oscilloscope with GPIB/IEEE-488 interface installed, and U.S. line cord select:

	Model
Basic Oscilloscope	PM 3094
GPIB/IEEE-488	/403
Complete Model Number	PM 3094/483

Accessories (Also see end of Section 2)

Passive Probes

PM 9011/001 Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 100 MHz (in 10:1 mode), 10 MHz (in 1:1 mode)
PM 9021/001 Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 200 MHz (in 10:1 mode), 10 MHz (in 1:1 mode)
PM 9001/001 Modular 1:1 Probe, 1.5m (5 ft) Cable
PM 9001/091 Modular 1:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 9001/201 Modular 1:1 Probe, 2.5m (8 ft) Cable
PM 9001/291 Modular 1:1 Probe, 2.5m (8 ft) Cable, Auto Range Indicator and Command Button
PM 9010/001 Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable
PM 9010/091 Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 9010/201 Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable
PM 9010/291 Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable, Auto Range Indicator and Command Button
PM 9020/001 Modular 200 MHz 10:1 Probe, 1.5m (5 ft) Cable
PM 9020/091 Modular 200 MHz 10:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 9100/001 Modular 100:1 Probe, 1.5m (5 ft) Cable
PM 9100/091 Modular 100:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 8918/002 Set of two 10:1 Probes, one Grey, one Red, 1.5m (5 ft)
PM 8918/202 Set of two 10:1 Probes, one Grey, one Red, 2.5m (8 ft)

Active Probes

PM 8940/09n High Voltage Isolation Amplifier with Auto Range
PM 8943A/00n 650 MHz FET Probe
PM 9355/09n 70 MHz AC Current Probe with Auto Range

Other Accessories

PM 8902A/001 12V DC Power Inverter
PM 8903A/00n Battery Pack, Charger, Inverter and Carrying Case
PM 8917/00n NTSC and PAL Video Sync Separator and Line Selector
PM 8960/04 Retrofittable Rack Mount
PM 8978/011 Adapter for PM 9381 Camera
PM 8978/021 Adapter for Tektronix® Camera
PM 8989/031 Traveller Carrying Case
PM 8991/041 Oscilloscope Cart
PM 8992/80 Accessory Pouch

PM 3082, PM 3084, PM 3092 & PM 3094

PM 9051 BNC to 4 mm Banana Adapter
PM 9381 Oscilloscope Camera System
PM 2122/002 50Ω Coaxial Switch
TC100 Instrument Cart
TC 100-01 Optional Power Strip for TC100 (U.S. only)
TC 100-02 Optional Drawer for TC100
TC 100-03 Optional CPU Bracket for TC100
TC 100-04 Optional Power Strip, Drawer, and CPU Bracket for TC100 (U.S. only)

The n' indicates the required line cord. To select your line cord substitute the n' by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

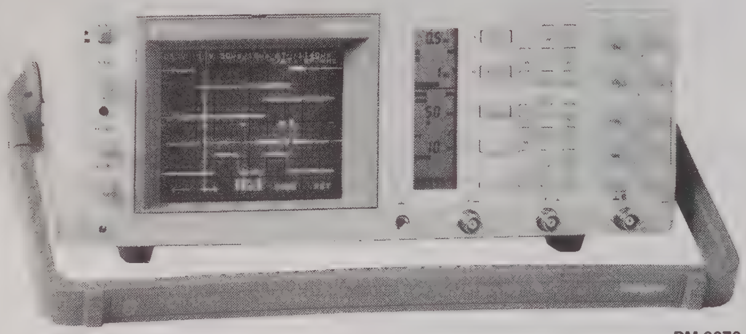
Manuals
PM 30xx SCPI Programming*
PM 30xx Service
PM 3092 Operator*
PM 309x Operating Guide*
PM 309x Reference*
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
Three-year product warranty. Five-year CRT warranty.

PM 3050, PM 3055, PM 3065 & PM 3070



PM 3070

PM 3050/55 60 MHz & PM 3065/70 100 MHz Analog Oscilloscopes
AUTOSET for automatic amplitude, time, and trigger setting
LCD panel displays status and settings
16 kV CRT acceleration voltage
Fast action up/down controls and cold switching
GPIB/IEEE-488 interface option
Single time base, dual time base and cursor versions

The 60/100 MHz Standards

The PM 3050 to PM 3070 series consists of four models which are all optionally available in rack mount versions for systems use. These are:

- PM 3050 60 MHz 2 channel, single time base
- PM 3055 60 MHz 2+1 channel, dual time base
- PM 3065 100 MHz 2+1 channel, dual time base
- PM 3070 100 MHz 2+1 channel, dual time base with clever cursors

Each unit represents a significant step forward in scope technology through their use of microcomputer control to both speed up and simplify the task of signal measurements.

Standard features in all models include AUTOSET for single pushbutton set up; a large backlit LCD showing all operating parameters; fast up/down rocker keys and cold switching for high reliability.

Measurements In Seconds

Just press the green AUTOSET button and automatic setting of channel amplitude, time base sweep speed and triggering takes place, for any signal. If only one channel is connected only one channel is displayed but if both channels are being used then both are automatically scaled and displayed. Triggering takes place on the lower frequency channel to give a clear jitter free display. AUTOSET eliminates time consuming manual range finding and adjustment to give fast accurate results at the touch of one button.

Clean and Simple Operation

With up/down rocker keys for amplitude and time base speed selection and pushbuttons for display mode and trigger source selection the operation of this series of oscilloscopes is kept clean and simple. Upon each user action the backlit LCD display is immediately updated making at a glance review of the scopes current parameter settings possible rather than having to search the complete front panel to determine the operating conditions.

The internal microcomputer prevents illegal setups like incorrect main and delayed time base settings and clearly identifies on the display non-calibrated amplitude settings or grounded inputs. This avoids incorrect measurements, wasted time and frustration.

To speed accurate measurements when using the delayed time base, the LCD gives a digital readout of the delay time so making the calculation of MTB sweep speed x delay time vernier redundant. For infrequent scope users the MENU key functions as a 'help' key showing the facilities offered by each key on the scope and quickly acquainting the user with its operation.

High Reliability and Easy Service

Behind the pushbutton operation all input signals are switched by hermatically sealed long life reed relays. These keep out damp and dirt from the active signal paths and ensure long life and long term measurement stability.

The advanced modular construction of these scopes allows complete functional testing of each subassembly before they are built together to form a complete instrument. An extended burn-in period lasting 48 hours then follows before another series of extensive tests takes place. This ensures that zero hour defects are almost completely eliminated and results in long term trouble-free operation. In the unlikely event that a failure should occur the modular construction enables easy access to the suspect board without major disassembly.

Advanced CRT

With 16 kV acceleration and advanced electron optics the CRT display has exceptional brilliance combined with a small spot size making it ideal for measurements on high speed or low repetition rate signals. The effective screen area is a full 8 x 10 cm. An internally etched graticule is provided for accurate and parallax-free measurements. Graticule illumination is standard on all models.

Fast Computer Hook Up

For systems use this smart scope series can be simply controlled by the GPIB/IEEE-488* bus using the PM 8953A interface. This retrofittable interface enables the scopes to be automatically set up for production testing or QA applications.

Clever Cursors

The PM 3070 offers full cursor measurement capabilities in both time and amplitude axes. Control of all cursor functions is by five keys in the bezel of the CRT which also are used to independently control the intensity of the alphanumerics and the cursor intensity. Accurate measurements of peak to peak values, voltage ratios, rise times, phase relationships and time ratios are possible with direct numerical display on the CRT.

A special facility called the ZOOM function enables the signal between the cursors to be expanded to fill the full width of the screen by automatically adjusting the delay time and delay time base speed. This makes it easy to zoom in on a particular point of interest without having to consider how to set up the delay time section. In addition to the measured data both channel and time base status is displayed on screen and user text or messages can also be specified.

PM 3050 60 MHz 2 Channels, Single Time Base

With all the standard facilities of the smart scope series this basic instrument provides comprehensive trigger facilities like TV line, TV frame,

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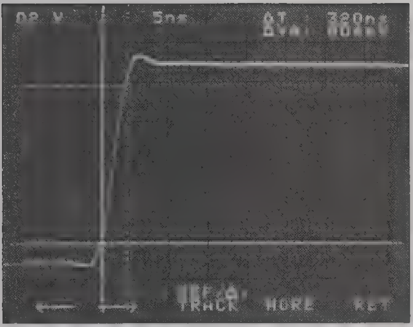
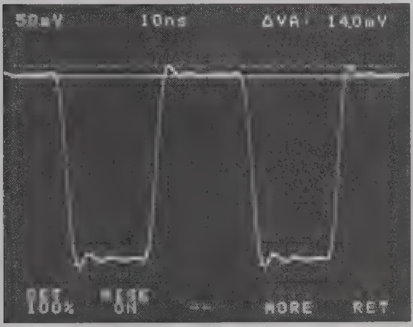
**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3050, PM 3055, PM 3065 & PM 3070



The four cursors of the PM 3070 enable accurate rise time measurements on fast pulses to be made quickly.



In the cursor amplitude mode of the PM 3070 absolute measurements or ratio measurements can be made, overshoot or preshoot can now be measured in volts or as a percentage.

Peak-Peak Auto and dc coupling in addition to trigger hold off. Time base speeds to 5 nsec per division are standard as well as x1 and x10 probe identification. X deflection via either channel is possible.

PM 3055 60 MHz 2+1 Channels, Dual Time Base

The external trigger input of this scope doubles as a third input channel with a fixed attenuation. The Delayed Time Base facility can be directly triggered from the main time base or from either input channel. Display of MTB intensified and DTB is possible at the same time or independently.

PM 3065 100 MHz 2+1 Channels, Dual Time Base

Triggering to 150 MHz plus the high intensity CRT makes this unit the ideal general purpose workhorse.The fast 3.5 nsec rise time and good pulse response characteristics make the PM 3065 the ultimate 100 MHz oscilloscope.

PM 3070 100 MHz 2+1 Channels, Dual Time Base, Clever Cursors

The clever cursors provide both amplitude and time measurement capabilities. In the amplitude mode peak to peak, ratio and 10% and 90% levels (for rise times) can be read directly from the display.

In the time mode, rise times, ratio and phase measurements can be made and read from the display. In addition the ZOOM facility enables fast pinpointing and expansion of a specific section of the measured signal.

Specifications

Technical Specifications

AUTOSET: Autoset selects proper channel, sets vertical deflection, time base speed and triggering for easy-to-read display of input signals.

Vertical Deflection

Display Modes: Ch A, Ch B, -Ch B, Ch A + Ch B, Ch A - Ch B, YB
Trigger View: In any combination, chopped or alternate (not PM 3050)

Frequency Response

PM 3065/70: DC to >100 MHz -3 dB (20 mV/div to 10 V/div); dc to >75 MHz -3 dB (2 mV/div to 10 mV/div)
PM 3050/55: DC to >60 MHz -3 dB (20 mV/div to10 V/div); dc to >35 MHz -3 dB (2 mV/div to 10 mV/div)
In AC Mode: Lower -3 dB point is <10 Hz

Rise Time

PM 3065/70: <3.5 ns (20 mV/div to 10 V/div); <4.9 ns (2 mV/div to 10 mV/div)
PM 3050/55: <6 ns (20 mV/div to 10 V/div) <10 ns (2 mV/div to 10 mV/div)
Deflection Coefficient: 2 mV/div to10 V/div in steps of 1, 2, 5 sequence
Error Limit: 3%, continuous control between steps with > flashing in LCD as warning symbol for uncal amplitude
Input Impedance: 1 MΩ ±2%//20 pF ±2 pF
Max. Rated Input Voltage: 400V (dc + ac peak)
Dynamic Range: >24 div at 10 MHz; >8 div at 100 MHz (PM 3065/70); >8 div at 60 MHz (PM 3050/55)
CMRR: 100:1 at 1 MHz

Trigger View

Frequency Response

PM 3065/70: DC to >100 MHz -3 dB (via ext); dc to >75 MHz -3 dB (Ch A or Ch B)
PM 3050/55: DC to >-3 dB (via ext 0°C to 35°C); dc to >50 MHz -3 dB (via Ch A or Ch B)
Deflection Coefficient: 100 mV/div via Ext Input 2 mV/div to 10 V/div via Ch A or Ch B

Horizontal Display Modes

PM 3055/65/70: MTB, MTBI, Alt TB, DTB, X-deflection
PM 3050: TB, X-deflection

Main Time Base (MTB or Time Base (TB)

Time Coefficients: 0.5 s/div to 50 ns/div in steps of 1, 2, 5 sequence
Magnifier: x10
Fastest Sweep Speed: 5 ns/div
Error Limit: 3%
Error Limit Magnifier Sweep: 4%, Continuous control between steps with > flashing in LCD as warning symbol for uncal sweep
Hold-Off: Continuously adjustable up to 10x min value

Delayed Time Base (DTB) (not PM 3050)

Time Coefficient: 1 ms/div to 50 ns/div in steps of 1, 2, 5 sequence
Magnifier: x10
Fastest Sweep Speed: 5 ns/div
Error Limit: 3%
Error Limit Magnifier Sweep: 4%
Trace Separation: >±4 div DTB shift only

Delay Time Base Multiplier (DTM) (not PM 3050)

Resolution: 1:10,000
Error Limit Total: 4% (in x10 magnifier)
Delay Time Jitter: 1 in >20,000

Triggering (MTB or TB)

Trigger Modes: Auto (free run), Non-Auto Triggered, Single
Trigger Sources: Ch A, Ch B Composite (Ch A, Ch B), Ext. (dc or ac), Line LCD indicates "Not triggered," "Triggered" or "Armed" status
Trigger Coupling: Peak to peak (p-p), dc, TVL, TVF

Triggering (DTB) (not PM 3050)

Starts, Ch A, Ch B, Composite (Ch A, Ch B), ext TVL (only if MTB TV selected)

Trigger Sensitivity

PM 3050/55	Internal	External
10 MHz	0.5 div	50 mV
60 MHz	1 div	150 mV
100 MHz	3 div	500 mV
TVF/TVL	0.7 div sync	70 mV sync
Level Range	±8 div	±800 mV

PM 3065/70	Internal	External
10 MHz	0.5 div	50 mV
100 MHz	1.2 div	150 mV
150 MHz	2 div	500 mV
TVL/TVF	0.7 div sync	70 mV sync
Level Range	±8 div	±800 mV

Slope positive (_/¯), or negative (¯_), TVF or TVL positive (+) or negative (–)

X-Deflection

Deflection Coefficient: Via Ch A or Ch B, 2 mV/div to 10 V/div; via ext input 100 mV/div
Frequency Response: DC to 2 MHz
Error Limit: 5%

PM 3050, PM 3055, PM 3065 & PM 3070

Phase Shift: <3° (at 100 kHz)
External Input: 1 MΩ ±2%//20 pF ±2 pF
Maximum Input Voltage: 400V (dc + ac peak)

Cursor Measurements (PM 3070)
Features: V, t, 1/t, Ratio
Phase,
Rise Time (4 way cursors),
Zoom
Settings: User text, Settings readout,
Intensity control independent of trace

Output Options

Y Signal out from Channel A (not PM 3065/70)
Deflection Coefficient: 100 mV/div, load 10 kΩ; 40 m/div, load 50Ω

Frequency Response
PM 3065/70: >75 MHz -3 dB
PM 3050/55: >60 MHz -3 dB
MTB Sweep Out: Output voltage 0.5V/div; load 1 MΩ
MTB Gate Out: High when running MTB sweep; otherwise low; voltage output high >2.4V; low <0.4V
DTB Gate Out: High when running MTB sweep; otherwise low; voltage output high >2.4V; low <0.4V

General Specifications

Display: CRT 8 x 10 cm viewing area, P31 phosphor, 16 kV acceleration voltage. Parallax-free graticule with continuously variable illumination. Separate LCD for display of menus, settings, status indications, etc. LCD is constantly illuminated by backlighting.

Power Supply

Safety requirements meet following specifications: IEC 348 Class I, UL 1244, CSA Certified (CSA 556B), VDE 0411.
Line Voltage: 100V to 240V ±10% in one range
Line Frequency: 50 Hz to 400 Hz ±10%
DC Nominal Voltage: 145V to 335V

Power Consumption (AC Source):
PM 3050/55: 50W
PM 3065/70: 60W

Miscellaneous
Calibration Output: 1.2V ±1%
Frequency: 2 kHz
Z-modulation Input: TTL-compatible, >2.0V blanks display; <0.8 max intensity, analog control possible between 2.0V and 0.8V

Environmental Data

Temperature
Rated Range of Use: +10°C to +40°C
Limited Range of Operation: 0°C to +50°C
Storage: -40°C to +75°C

Altitude
Operating: 15,000 ft (4,500m)
Non-Operating: 40,000 ft (12,000m)

Humidity: 95% RH
EMI: Meets requirements of MIL-STD-461 Class B, VDE 0871 and VDE 0875 Grenzwert-klasse B

Shock
Operating and Non-Operating: 30g, ½ sine, 11 ms duration, 6 shocks in each direction (3 each face), for a total of 18 shocks
Vibration: 5 Hz to 55 Hz, 15 minutes along each of three axes, with a maximum acceleration of 3g. Resonance dwell of 10 minutes at each frequency where resonance occurs, or at 33 Hz when no resonance found.
Bench Handling: MIL-STD-810, method 516, procedure V. The PM 3050/55/65/70 are designed to meet the requirements of MIL-T-28800 D, Type III, Class 5, Style D.

Mechanical Data

Width
Incl Handle: 387 mm (15.2 in)
Excl Handle: 350 mm (13.8 in)

Length
Incl Handle, Excl Knobs: 518 mm (20.4 in)
Excl Handle and Knobs: 433.5 mm (17.1 in)
Incl Handle and Knobs: 530.5 mm (20.9 in)
Excl Handle, Incl Knobs: 455.7 mm (17.9 in)

Height
Incl Feet: 146.5 m (5.8 in)
Excl Feet: 134.5 mm (5.3 in)
Excl Lower Cabinet: 132.5 mm (5.2 in)
Weight: Approx 7.5 kg (16.5 lb) excl access

Ordering Information

Models

PM 3050 60 MHz Oscilloscope
PM 3052 Same, with Rack Mount
PM 3055 60 MHz Oscilloscope w/delayed sweep
PM 3057 Same, with Rack Mount
PM 3065 100 MHz Oscilloscope w/delayed sweep
PM 3067 Same with Rack Mount
PM 3070 100 MHz Oscilloscope w/delayed sweep
PM 3072 Same, with Rack Mount

Included with Instrument

Three-year product warranty, five-year CRT warranty, two 100 MHz 10:1 probes, model PM 8926/591 or equivalent, with 1.5m (5 ft) cable and scale factor readout, blue CRT contrast filter, operator and reference manual (a service manual is available upon return of reply card included with each instrument), and Certificate of Calibration Practices.

Optional Configurations

When ordering, select basic "PM" model number, and add the configuration option number listed below as a suffix.

/00n Standard Version
/11n CRT with P7 Long Persistence Phosphor
/76n Y Signal Output (limited to 75 MHz on 100 MHz models), plus MTB Gate + DTB Gate Outputs (MTB Gate only on PM 3050 and PM 3052)
/77n Y Signal Output (limited to 75 MHz on 100 MHz models), plus MTB Gate + DTB Gate Outputs (MTB Gate only on PM 3050 and PM 3052), CRT with P7 Long Persistence Phosphor

All options are factory installed only.

The n' indicates the required line cord. To select your line cord substitute the n' by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

Example, Ordering Configuration

To order a 100 MHz Oscilloscope in rack mountable configuration, with CRT option, and U.S. line cord select:

	Model
Basic Oscilloscope	PM 3072
P7 Phosphor	/113
Complete Model Number	PM 3072/113

Accessories (Also see end of Section 2)
Passive Probes
PM 9011/001 Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 100 MHz (in 10:1 mode), 10 MHz (in 1:1 mode)
PM 9021/001 Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 200 MHz (in 10:1 mode), 10 MHz (in 1:1 mode)
PM 9001/001 Modular 1:1 Probe, 1.5m (5 ft) Cable
PM 9001/091 Modular 1:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 9001/201 Modular 1:1 Probe, 2.5m (8 ft) Cable
PM 9001/291 Modular 1:1 Probe, 2.5m (8 ft) Cable, Auto Range Indicator and Command Button
PM 8926/591 10:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator
PM 9010/001 Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable
PM 9010/091 Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button

PM 3050, PM 3055, PM 3065 & PM 3070

PM 9010/201 Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable
PM 9010/291 Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable, Auto Range Indicator and Command Button
PM 9100/001 Modular 100:1 Probe, 1.5m (5 ft) Cable
PM 9100/091 Modular 100:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator and Command Button
PM 8918/002 Set of two 10:1 Probes, one Grey, one Red, 1.5m (5 ft)
PM 8918/202 Set of two 10:1 Probes, one Grey, one Red, 2.5m (8 ft)

Active Probes
PM 8940/09n High Voltage Isolation Amplifier with Auto Range
PM 8943A/00n 650 MHz FET Probe
PM 9355/09n 70 MHz AC Current Probe with Auto Range

Other Accessories
PM 8902A/001 12V DC Power Inverter
PM 8903A/00n Battery Pack, Charger, Inverter and Carrying Case
PM 8917/00n NTSC and PAL Video Sync Separator and Line Selector
PM 8953A/00n External Retrofittable GPIB/IEEE-488 Interface
PM 8988 Protective Front Panel Cover
PM 8989/001 Traveller Carrying Case
PM 8991/041 Oscilloscope Cart
PM 8992/80 Accessory Pouch
PM 9051 BNC to 4 mm Banana Adapter
PM 9381 Oscilloscope Camera System
TC100 Instrument Cart
TC 100-01 Optional Power Strip for TC100 (U.S. only)
TC 100-02 Optional Drawer for TC100
TC 100-03 Optional CPU Bracket for TC100
TC 100-04 Optional Power Strip, Drawer, and CPU Bracket for TC100 (U.S. only)

The n' indicates the required line cord. To select your line cord substitute the n' by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

Manuals
PM 3050/52 Operator*
PM 3050/52 Service*
PM 3055/57 Operator*
PM 3055/57 Service*
PM 3065/67 Operator*
PM 3065/67 Service*
PM 3070 Operator*†
PM 3070 Service*†

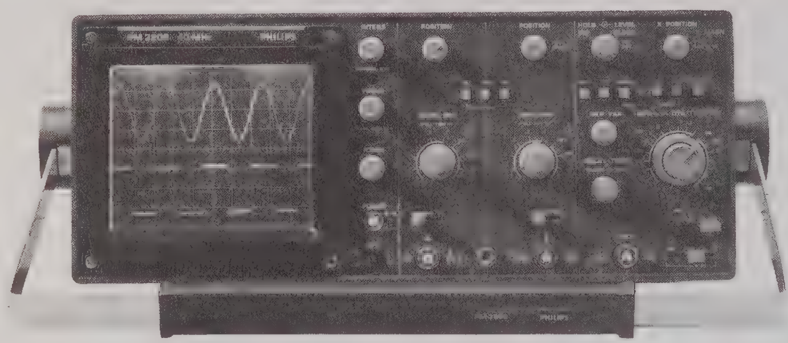
**No charge with purchase of unit*
†Use with PM 3065 Operator or Service Manual

Customer Support Services

Also see Section 20.

Factory Warranty
Three-year product warranty. Five-year CRT warranty.

PM 3208 & PM 3209



PM 3209

PM 3208 20 MHz & PM 3209 40 MHz Analog Oscilloscopes*

- Dual channel operation at 20 MHz (PM 3208) or 40 MHz (PM 3209)
- Delayed time base on PM 3209
- 1 mV/div. sensitivity for low level measurements
- XY mode for time independent phenomena
- TV line and frame triggering
- Full 8 x 10 cm screen with illumination
- Supplied complete with probes

The PM 3208 and PM 3209 give full performance, ease of use, and reliability at a price much lower than you would expect from such a professional instrument. Their comprehensive specification and guaranteed performance are fully supported to ensure you of many years of faithful and trouble free service.

Easy-to-Use Versatility

High performance starts with clear, easy operation. A logical front-panel layout puts every function at your fingertips. So you can get to work fast, and get the results you need every time.

These scopes give you dual-channel operation, with bandwidth of 20 MHz (PM 3208) or 40 MHz (PM 3209).

Powerful Delayed Time Base Facility (PM 3209 only)

The DTB is easy to use, and lets you select any waveform section for close examination. You can effectively 'zoom in' up to 1000 times by using a different, faster timebase speed for that section. An important extra capability at no additional cost, which gives you much more than a simple magnification function!

Precise Measurement Results

The high input sensitivity of both instruments goes right down to 1 mV/div. in the 5x setting. So you can view low-level signals clearly - for example from magnetic pick-up heads and other transducers. Risetime is fast 8.8 ns for the PM 3209 (PM 3208: 17.5 ns) for accurate representation of high-speed signal peaks or square waves.

If your work involves electronic service, you'll appreciate the TV triggering facility that these scopes give you. Triggering may be on line or frame, so you can isolate and view exactly the signal you want. While for video sinals or complex digital pulse trains, there's an adjustable trigger hold-off to give you a clear, stable display every time.

More Professional Facilities

Another valuable facility of these professional instruments is the XY mode: the capability to display a signal not as a function of time, but as a function of another, separate signal. You'll find this mode gives you easy solutions for checking circuit and filter frequency characteristics, making input vs. output measurements, or mechanical observations like pressure vs. displacement.

There's also a rear-panel Z-modulation input, at which you can apply a signal to blank parts of the display at controlled time intervals. This function gives you valuable extra display versatility in the XY mode, when neither of the signals shown is also provided to connect an external counter, for example.

The PM 3209 adds a variable delayed sweep; an addition facility that allows viewing of both the original signal and a delayed sweep signal

Bright, Clear Display

For superior waveform display, these instruments have a large, high-performance flat 8 x 10 cm screen with an integral graticule scale for parallax-free read-out. Acceleration voltage is a high 12.5 kV on the PM 3209, to ensure a bright trace at this model's high writing speeds. While adjustable focusing and scale illumination allow optimum viewing of every signal.

Value That's Unmatched Anywhere

With performance like this, the PM 3208 and PM 3209 take the high ground in low-cost oscilloscopes. By giving you just what you need to handle a wide range of everyday oscilloscope applications in education & training, service, quality assurance and much more. All at a price that represents unbeatable value for money.

Specifications

Technical Specifications

Vertical Amplifier (ChA and ChB Identical)

Operating Modes: ChA, ChB, -ChB, ChA and ChB, ChA + ChB, ChA - ChB, ALT, CHOP
Sensitivity: 5 mV - 5V/div., ±5% in 1-2-5 steps, 1 mV - 1V/div in x5 MAGN
Bandwidth DC: PM 3208 DC to 20 MHz (-3 dB); PM 3209 DC to 40 MHz (-3 dB)
Bandwidth AC: PM 3208 10 Hz to 20 MHz, (-3 dB); PM 3209 10 Hz to 40 MHz, (-3 dB)
Input Impedance: 1 MΩ, 30 pF
Rise Time: Less than 17.5 ns (PM 3208); less than 8.8 ns (PM 3209)
Chopping Frequency: 250 kHz approx
Maximum Input Voltage: 400V (dc + ac peak)
Input Coupling: AC, GND, DC

Horizontal Amplifier

Operating Modes: X-Y operation (ChA-X, ChB-Y)
Sensitivity: 5 mV to 5V/div, ±10% in 1-2-5 steps
Bandwidth DC: DC to 1 MHz (-3 dB); 10 Hz to 1 MHz (-3 dB)
X-Y Phase Shift: 3° or less (at 50 kHz)

**Available in European countries only*

PM 3208 & PM 3209

Time Base

Sweep Mode: AUTO, NORMAL, SINGLE
Sweep Time: 0.2 µs to 0.5 s/div., ±3% in 1-2-5 steps
Delayed Sweep: 0.2 µs to 0.5 ms/div. in 1-2-5 steps (PM 3209)
Error Limit: ±3%
Sweep Magnifier: 10 times
Error Limit - Magnified Sweep: ±5%
Fastest Sweep Speed: 20 ns/div.
Hold-Off: contiuously adjustable
Delay Method: contiuous delay and adjustment (PM 3209) delay time: 20 ns to 5s
Maximum Delay Time Jitter: 1: 10000

Triggering

Trigger Sources: ChA, ChB, LINE, EXT
Trigger Coupling: AC, DC, AC-LF, TVL, TVF

Trigger Sensitivity

	PM 3208	PM 3209
Internal	DC-1 MHz, 1div DC-20 MHz, 2div	DC-1 MHz, 1div DC-40 MHz, 2div
External	DC-1 MHz,150 mV, DC-20 MHz,300 mV	DC-1 MHz, 150 mV DC-40 MHz, 300 mV
Trigger level preset function		

General Specifications

CRT Display

8 x 10 cm rectangular, domed mesh and post accelerator type with illuminated, parallax-free, internal graticule; 2 kV accelerating potential (PM 3208); 12.5 kV (PM 3209)
8 x 10 division graticule (1 div. = 10 mm)

Vertical Amplifier Signal Output

Output Voltage: 50 mV/div. into 50Ω; 100 mV/div. into 1 MΩ
Bandwidth: PM 3208 dc to 20 MHz (-3 dB); PM 3209 dc to 40 MHz (-3 dB)

Intensity Modulation (Z-axis)

Maximum Input Voltage: 42V (dc + ac peak), 1 kHz maximum
Sensitivity: 3V p-p

Probe Calibrator Output Voltage

Square Wave (approx.): 1 kHz, 1V

Power Required

Voltage: AC, 100V/120V/220V/240V, ±10% 50 Hz to 400 Hz
Power (max): 40W (PM 3208); 40W (PM 3209)

Mechanical Data

Size: 147 mm H x 356 mm W x 435 mm L (6 in H x 14 in W x 17.5 in L)
Weight: 8 kg (17.6 lb) (PM 3208); 9 kg (19.8 lb) (PM 3209)

Environmental Capabilities

Meets requirements of MIL-T-28800DF, type III, class 5, style E.

Ambient Temperature
Rated Range of Use: +5°C to +35°C
Storage and Transit: -20°C to +71°C

Altitude
Operating: 4500m/14700 ft.
Non-Operating: 12000m/39000 ft.
Humidity: 80% (rel.)
Shock: 30g half sine wave of 11 ms duration, 18 shocks
Vibration: in three directions
0.7g, 7 min., 5 Hz to 15 Hz
1.3g, 3 min., 15 Hz to 25 Hz
2.0g, 5 min., 25 Hz to 35 Hz

Safety

Meets requirements of IEC 348 Class I

Ordering Information

Models

PM 3208/00n* 20 MHz Analog Oscilloscope
PM 3209/00n* 40 MHz Analog Oscilloscope
Note: n defines power cord option

Included with Instrument
Two switchable 10:1 ,1:1 probes, operating and service manual, power cord, and spare fuse.

Accessories (Also see end of Section 2)

Passive Probes
PM 8926/591 10:1 Probe, 1.5m (5 ft) Cable, Auto Range Indicator
PM 9001/001 Modular 1:1 Probe, 1.5m (5 ft) Cable
PM 9001/201 Modular 1:1 Probe, 2.5m (8 ft) Cable
PM 9010/001 Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable
PM 9010/201 Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable
PM 9011/001 Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 100 MHz (in 10:1 mode), 10 MHz (in 1:1 mode)
PM 9100/001 Modular 100:1 Probe, 1.5m (5 ft) Cable

Active Probes
PM 8940/09n High Voltage Isolation Amplifier with Auto Range
PM 9355/09n 70 MHz AC Current Probe with Auto Range

Other Accessories
PM 8902A/001 12V DC Power Inverter
PM 8903A/00n Battery Pack, Charger, Inverter and Carrying Case
PM 8991/041 Oscilloscope Cart

**Available in European countries only*

Accessories

Compatibility Chart

Many oscilloscope accessories are available to enhance the performance of the instruments. The following pages give details on the wide range of accessories offered along with their performance characteristics.

Accessory Compatibility Chart
Use this chart to see which oscilloscope accessories are compatible with the oscilloscopes listed on the right.

		PM 3382/84	PM 3392/94	PM 3384E	PM 3350A/55/65A/75	PM 3335	PM 3082/84	PM 3092/94	PM 3050/55/65/70	PM 3208/09	PM 3340
Passive Probes											
PM 8911/081	Low impedance wide bandwidth 10:1 probe										(1)
PM 8911/091	Low impedance wide bandwidth 10:1 probe		•					•			
PM 8912/081	Low impedance wide bandwidth 100:1 probe										•
PM 8912/091	Low impedance wide bandwidth 100:1 probe		•					•			
PM 8926/591	Modular general purpose 10:1 probe				(1)	(1)			(1)	•	
PM 9011/001	Switchable 1:1 or 10:1 probe	•		•	•	•	•		•	•	
PM 9021/001	Switchable 1:1 or 10:1 probe		•		•	•		•	•	•	
PM 9001/001	Modular 1:1 probe				•	•	•	•	•	•	
PM 9001/091	Modular 1:1 probe	•	•	•	—	—	•	•	—		
PM 9001/201	Modular 1:1 probe				•	•	•	•	•	•	
PM 9001/291	Modular 1:1 probe	•	•	•	—	—	•	•	—		
PM 9010/001	Modular general purpose 10:1 probe	•		•	•	•	•		•	•	
PM 9010/091	Modular general purpose 10:1 probe	(1)		(1)	•	•	•		•		
PM 9010/201	Modular general purpose 10:1 probe	•		•	•	•	•		•	•	
PM 9010/291	Modular general purpose 10:1 probe	•		•	•	•	•		•		
PM 9020/001	Modular wide bandwidth probe		•					•			
PM 9020/091	Modular wide bandwidth probe		(1)					(1)			
PM 9100/001	High impedance 100:1 probe	•	•	•	•	•	•	•	•	•	
PM 9100/091	High impedance 100:1 probe	•	•	•	•	•	•	•	•		
PM 8918/002	Safety probes 10:1 (set of two)	•	•	•	•	•	•	•	•	•	
PM 8918/202	Safety probes 10:1 (set of two)	•	•	•	•	•	•	•	•	•	
PM 8924/001	Modular 1:1 probe	•	•	•	•	•	•	•	•	•	
PM 8929/491	Modular 10:1 probe	•		•	•	•	(1)		•		
Passive Probe Accessory Sets											
PM 9002/001	General accessory set for PM 90XX probes										
PM 9003/001	Test lead and clip set for PM 90XX probes										
PM 9102/001	General accessory set for PM 91XX probes										
Active Probes											
PM 8940/09n	Isolation amplifier	•	•	•	•	•	•	•	•	•	
PM 8943A/00n	FET probe	•	•	•	•	•	•	•	•	•	•
PM 9355/09n	Current probe	•	•	•	•	•	•	•	•	•	
PM 8917/00n	Video line selector				•	•	•	•	•	•	
Battery Packs and Power Converters											
PM 8902A/001	12V DC to AC power converter	•	•	•	•	•	•	•	•	•	
PM 8903A/00n	Battery power kit	•	•	•	•	•	•	•	•	•	
Accessory Pouches and Carry Cases											
PM 8992/80	Full size pouch	•	•	•			•	•	•		•
PM 8992/65	Half size pouch				•	•					
PM 8989/00	Traveller carry case				•	•			•		
PM 8989/031	Traveller carry case	•	•	•	•	•	•	•	•		
Rack Mounts											
PM 8960/041	Rack Mount kit	•	•	•			•	•			
PM 8964/401	Rack Mount kit										•
PM 8968/001	Rack Mount kit									•	
PM 8969/001	Rack Mount kit				•	•			•		

• Means compatible and recommended
— Not compatible
n = power option

(1) Supplied with instrument
(S) Service installed option

Compatibility Chart (continued)

Accessory Compatibility Chart Use this chart to see which oscilloscope accessories are compatible with the oscilloscopes listed on the right.		PM 3382/84	PM 3392/94	PM 3384E	PM 3350A/55/65A/75	PM 3335	PM 3082/84	PM 3092/94	PM 3050/55/65/70	PM 3208/09	PM 3340
Cart											
TC100	Test Instrument Cart	•	•	•	•	•	•	•	•	•	•
PM 8991/04	Oscilloscope cart	•	•	•	•	•	•	•	•	•	
Camera and Adapters											
PM 9381	Camera kit for handheld use	•	•	•	•	•	•	•	•	•	
PM 8978/011	Camera bezel adapter for fixed use	•	•				•	•			
PM 8978/021	Camera (Tek C-5C, C7) bezel adapter	•	•				•	•			
Adapters and Terminators											
PM 9051	BNC (m) to Banana (f)	•	•	•	•	•	•	•	•	•	
PM 9053	BNC (f) to Banana (m)	—	—		—	—		—	—		
PM 9061	BNC (f) to BNC (f)										
PM 9063/001	N type (m) to BNC (f)										•
PM 9067/001	BNC T piece (m,m,f)	•	•	•	•	•	•	•	•	•	
PM 9585/001	50Ω 1W Terminator	•	•	•	•	•	•	•	•	•	
PM 9591/09*	Attenuator 10:1, 50Ω	•	•	•	•	•	•	•	•	•	
PM 9596//09*	Attenuator 100:1, 50Ω	•	•	•	•	•	•	•	•	•	
PM 9598/09*	Attenuator 10:1, 75Ω to 50Ω	•	•	•	•	•	•	•	•	•	
PM 9599/09*	Set of three attenuators above	•	•	•	•	•	•	•	•	•	
Coaxial Cables											
PM 9071	Banana to Banana, 135Ω, 1m (3 ft)										
PM 9072	BNC to Banana, 135Ω, 1m (3 ft)	•	•	•	•	•	•	•	•	•	
PM 9074	BNC to BNC, 50Ω, 1m (3 ft)	•	•	•	•	•	•	•	•	•	
PM 9075	BNC to BNC, 75Ω, 1m (3 ft)									•	
Interface Cards, Cables and Adapters											
Y8021	IEEE-488 cable, 1m (3.28 ft)	•	•		•	•	•	•	•		•
Y8022	IEEE-488 cable, 2m (6.56 ft)	•	•		•	•	•	•	•		•
Y8023	IEEE-488 cable, 4m (13 ft)	•	•		•	•	•	•	•		•
PM 8953A/00	Free standing IEEE-488 Interface								•		
PM 8957A	Retrofittable IEEE-488 Interface				•						
PM 8958A	Retrofittable RS-232 Interface				•						
PM 8959/001	Retrofittable IEEE-488/RS-232C Interface					•					
PM 8961/001	Retrofittable RS-232C dump only Interface					•					
PM 9076/011	Analog plot cable to banana plugs				•						
PM 9076/021	Analog plot cable to amphenol connector				•						
Y1709	RS-232C printer cable, 2m (6.56 ft) male/female DB-25 to DB-25				•						
PM 8914/001	CombiScope™ Serial Interface cable DB-9f to DB-9f	•	•								
Miscellaneous											
PM 8988	Front cover				•	•			•		
PM 8998	Memory backup								•		

• Means compatible and recommended
— Not compatible
** Usable in combination with 50Ω terminator (PM 9585/001) or a 50Ω scope input*

Accessories

Passive Probe Specifications

Model	Attenuation Factor	Useful BW (MHz)	Impedance Ω/pF	Max Input Voltage (DC + AC Peak)	Compensating Range (pF)	Cable Length (m) (ft)	Auto Range Indication	Command Pushbutton
PM 8911/081	10:1	2000	500//1	11	—	1.5 (5)	Yes	No
PM 8911/091	10:1	1500	500//1	11	—	1.5 (5)	Yes	No
PM 8912/081	100:1	2000	5k//1	35	—	1.5 (5)	Yes	No
PM 8912/091	100:1	1500	5k//1	35	—	1.5 (5)	Yes	No
PM 8918/002*	10:1	100	10M//15	600V rms, 6 kV surge	15 to 35	1.5 (5)	No	No
PM 8918/202*	10:1	75	10M//15	600V rms, 6 kV surge	15 to 35	2.5 (8)	No	No
PM 8926/591	10:1	100	10M//14	500	15 to 35	1.5 (5)	Yes	No
PM 8929/491	10:1	200	10M//13.5	500	15 to 35	1.5 (5)	Yes	No
PM 9011/001	1:1 10:1	7 100	1M//130 10M//14	42 500	— 15 to 35	1.5 (5)	No	No
PM 9021/001	1:1 10:1	7 200	1M//130 10M//14	42 500	– 15 to 35	1.5 (5)	No	No
PM 9001/001	1:1	15	1M//59	42	–	1.5 (5)	No	No
PM 9001/091	1:1	15	1M/59	42	–	1.5 (5)	Yes	Yes
PM 9001/201	1:1	12	1M//95	42	–	2.5 (8)	No	No
PM 9001/291	1:1	12	1M//95	42	_	2.5 (8)	Yes	Yes
PM 9010/001	10:1	100	10M//12	500	15 to 35	1.5 (5)	No	No
PM 9010/091	10:1	100	10M//12	500	15 to 35	1.5 (5)	Yes	Yes
PM 9010/201	10:1	100	10M//16.5	500	15 to 35	2.5 (8)	No	No
PM 9010/291	10:1	100	10M//16.5	500	15 to 35	2.5 (8)	Yes	Yes
PM 9020/001	10:1	200	10M//12	500	15 to 35	1.5 (5)	No	No
PM 9020/091	10:1	200	10M//12	500	15 to 35	1.5 (5)	Yes	Yes
PM 9100/001	100:1	200	20.2M//3.3	4000	15 to 35	1.5 (5)	No	No
PM 9100/091	100:1	200	20.2M//3.3	4000	15 to 35	1.5 (5)	Yes	Yes

The Command Pushbutton enables specific scope actions to be executed. The specific action is programmed by the user in the oscilloscope and may include such functions as AUTOSET, single shot or step to the next measurement setting. This function is implemented on the PM 3080 Series, PM 3090 Series, PM 3380 Series and PM 3390 Series.

Probes for which the extension of the type number ends with '81' have a N-type connector.

** Set of 2 probes*

Alternatives for Obsolete Probes

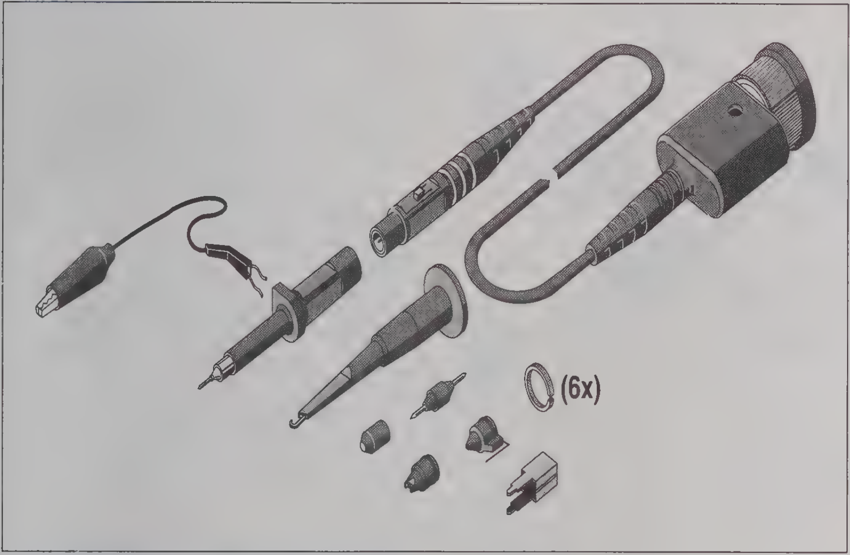
Obsolete Probe	Current Alternative Probes
PM 8921, PM 8924/001	PM 9001/001
PM 8921L, PM 8924/201	PM 9001/201
PM 9326, PM 8922/001, PM 8922/501	PM 9011/001
PM 9327, PM 9328, PM 9323	PM 9011/001
PM 9336, PM 8926/001, PM 8926/501	PM 9010/001
PM 8936/091, PM 8926/091	PM 9010/091
PM 8927 A, PM 8926/501	PM 9010/001
PM 8927 AL, PM 8926/201	PM 9010/201
PM 8927 AS	PM 9010/091
PM 8928, PM 8926/501	PM 9010/001
PM 8932, PM 8931/001	PM 9100/001
PM 8933/091	PM 9010/091
PM 8935, PM 8929/001	PM 9020/001
PM 8935 L, PM 8929/201*	PM 9020/001
PM 8926/291	PM 9010/291
PM 8931/091	PM 9100/091

** PM 8929/201 cable length was 2.5m; PM 9020/001 has 1.5m cable.*

Set of Accessories Supplied with General Purpose Probes

Ground lead with alligator clip
Mini PCB connector
Indication rings
Insulation cap
DIL insulation cap
Spring loaded test clip
Ground needle
Spare probe tip
Manual

1:1 Probes

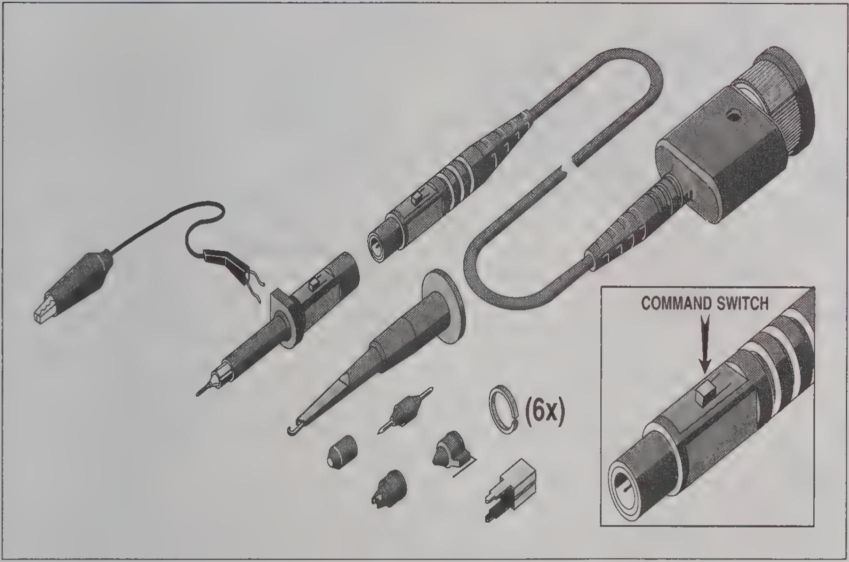


PM 9001/001
PM 9001/091
PM 9001/201
PM 9001/291

Modular 1:1 probes for high sensitivity measurements at lower frequencies. Equipped with command switch and range indicator (/x91 only). Cable length 1.5m (5 ft) (PM 9001/0xx) or 2.5m (8 ft) (PM 9001/2xx).

Each probe consists of:
Probe cable assembly
Probe body
Retractable hook tip
Ground lead and clip
Insulator sleeve
Spare probe tip
6 colored identification rings

10:1 100 MHz and 200 MHz Probes



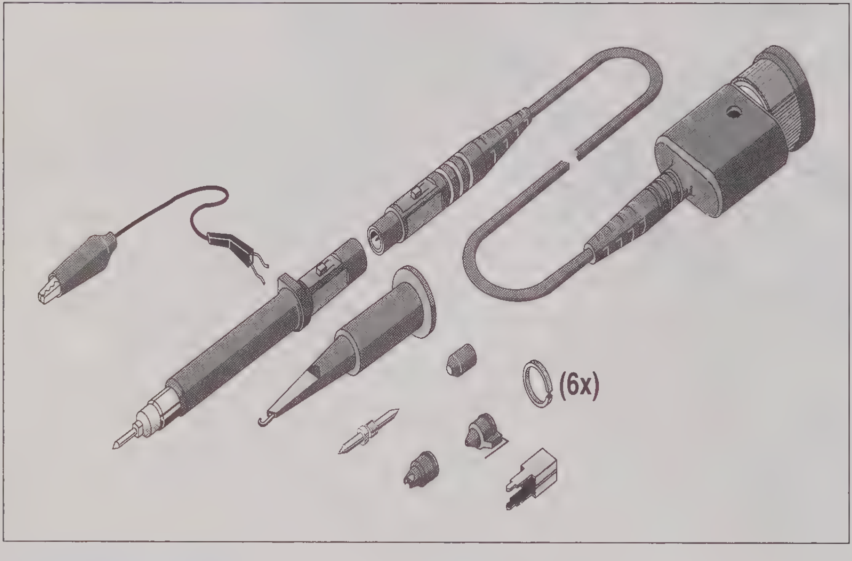
PM 9010/001
PM 9010/091
PM 9010/201
PM 9010/291
PM 9020/001
PM 9020/091

Modular 10:1 probes for a wide range of applications. Useful bandwidth 100 MHz (PM 9010) or 200 MHz (PM 9020). Equipped with command switch and range indicator (/x91 only). Cable length of 1.5m (5 ft) (/0x1) or 2.5m (8 ft) (/2x1).

Each probe consists of:
Probe cable assembly
Probe body
Retractable hook tip
Ground lead and clip
Insulator sleeve
Spare probe tip
6 colored identification rings

Accessories

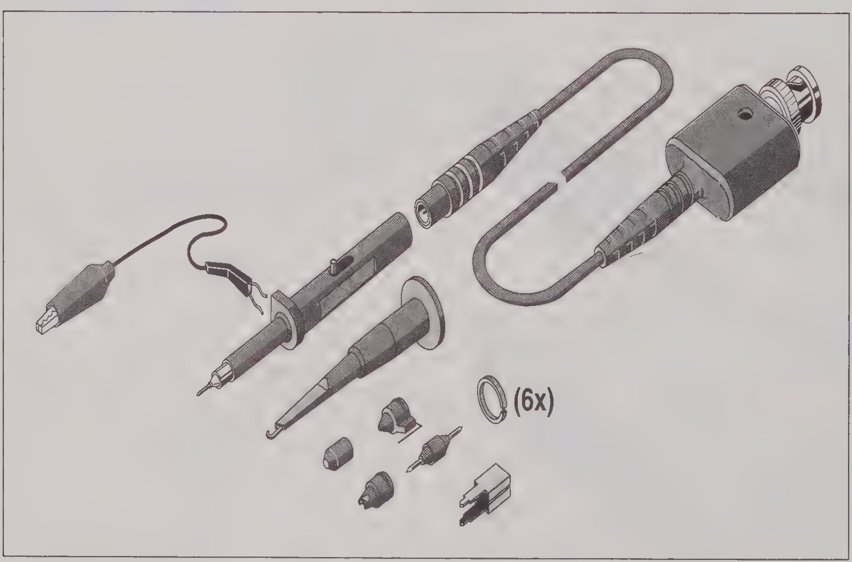
100:1 200 MHz Probes



PM 9100/001
PM 9100/091

High voltage probes with a 100:1 transfer ratio. High input impedance (20.2 MΩ) and high isolation voltage of the tip allow measurements up to 4 kV. Equipped with command switch and range indicator (/091 only). Cable length 1.5m (5 ft).
Each probe consists of:
Probe cable assembly
Probe body
Retractable hook tip
Ground lead and clip
Insulator sleeve
Spare probe tip
6 colored identification rings

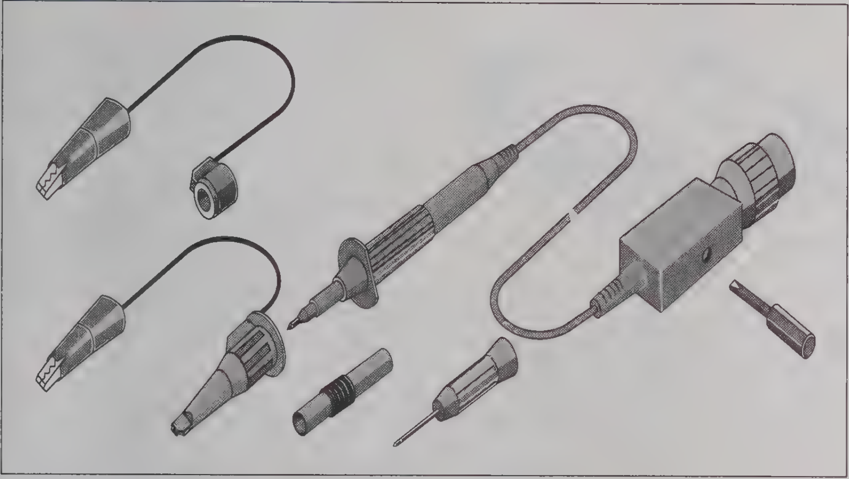
Switchable Probes



PM 9011/001
PM 9021/001

General purpose, switchable 1:1/10:1 probes. The 1:1 transfer ratio allows for high sensitivity measurements at low frequencies (bandwidth 7 MHz). When switched to 10:1 transfer ratio, bandwidth is 200 MHz (PM 9021) or 100 MHz (PM 9011).
Each probe consists of:
Probe cable assembly
Probe body
Retractable hook tip
Ground lead and clip
Insulator sleeve
Spare probe tip
6 colored identification rings

Safety Designed 10:1 Probes



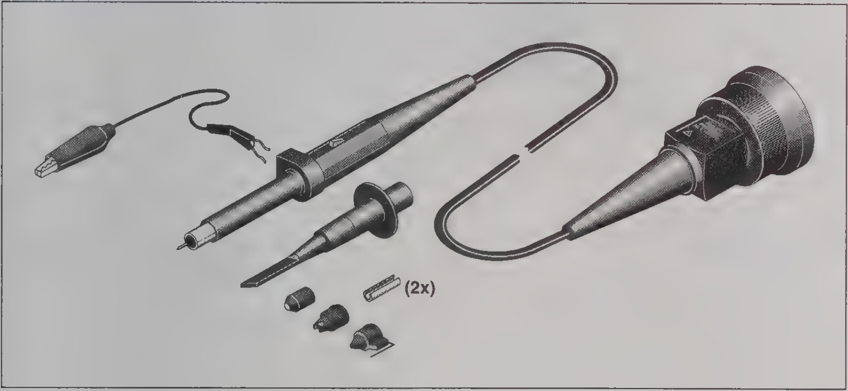
PM 8918/002
PM 8918/202

Set of two (one red, one grey) safety-designed 10:1 probes for oscilloscope use. The design is optimized for user's safety, double insulated according to IEC 1010-1. Maximum signal voltage is 600V rms, 6 kV surge. Overall length 1.5m (5 ft) (/002) or 2.5m (8 ft) (/202).

The probe set includes: slip-on ground leads, retractable hook tips with alligator ground clips, slip-on 2 mm test pins, probe tip to insulated banana adapter and screwdrivers for adjustment.

For these probes a wide range of adapters and grabbers are available, all based upon the same safety design (see ScopeMeter section of this catalog).

10:1 100 MHz Probes

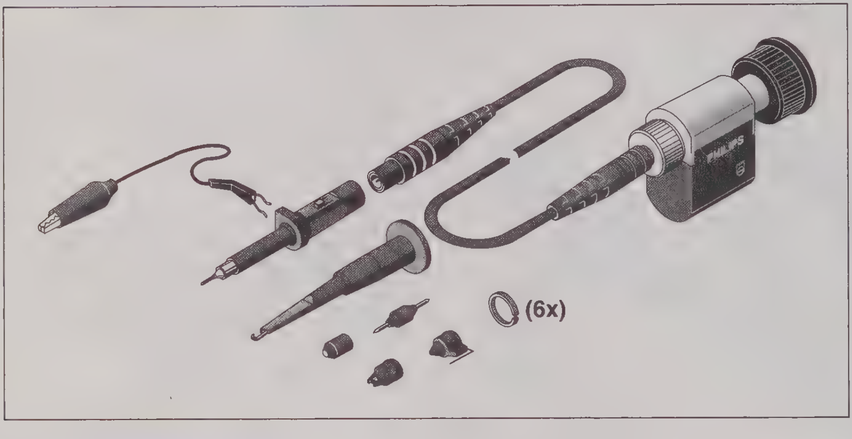


PM 8926/591

Compact, economy class general purpose 10:1 probe, equipped with range indicator. Useful bandwidth 100 MHz. Cable length of 1.5m (5 ft). Probe is supplied with hook tip, retractable ground lead, 2 isolation caps, color coding rings and ground contact spring.

Accessories

Modular 10:1 and 1:1 Probes



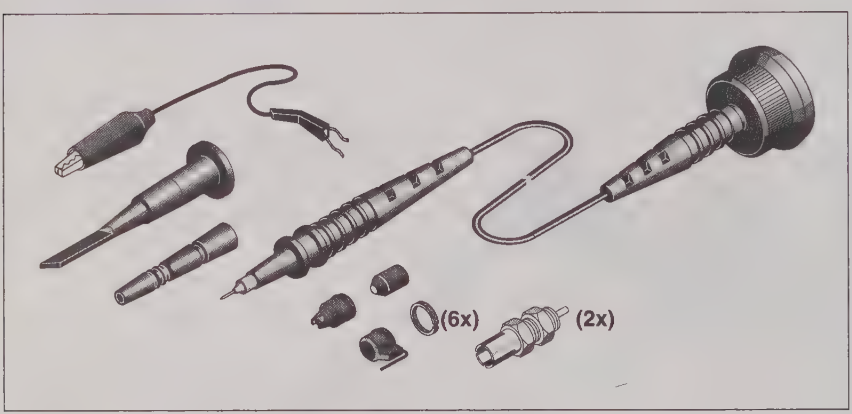
PM 8929/491

Modular 10:1 probe for wide bandwidth applications. Equipped with range indicator. Probe is supplied with hook tip, retractable ground lead, 2 isolation caps, color coding rings and ground contact spring.

PM 8924/001

Modular 1:1 probe for high sensitivity measurements at lower frequencies. Cable length 1.5m (5 ft). Supplied with retractable ground lead, insulation caps (2), color coding rings, wrap pin adapter and spare probe tips (2). (Maintenance type, limited availability).

Wide Bandwidth Probes



PM 8911/081
PM 8911/091
PM 8912/001
PM 8912/091

Passive probes with very low input capacitance (1 pF) for measurements into the GHz frequency range with minimal capacitive loading of the system under test. PM 8911 gives 10:1 transfer ratio at 500Ω input impedance, PM 8912 gives 100:1 transfer ratio at 5 kΩ input impedance. /081 indicates N type connector with range indicator, /091 indicates BNC connector with range indicator.

Probes require a 50Ω oscilloscope input impedance or must be used with 50Ω feedthrough termination PM 9585 (giving reduced bandwidth).
Each probe consists of:
Probe cable assembly
Probe body
Retractable hook tip
Ground lead and clip
Insulator sleeve
Spare probe tip
6 colored identification rings
Wire wrap adapter

*The **range indicator** enables an oscilloscope (if so equipped) to adjust the vertical deflection read-out and measurement results to be calculated with the correct probe attenuation taken into account.*
*The **command switch** adds more convenience to using of the probe: user-defined actions can be initiated by pressing a probe mounted button, just when hooked up to the test object. Actions can be for instance: initiate AUTOSET, select an instrument set-up or perform Touch Hold and Measure (this is: stop the acquisition and measure the main parameters of the acquired signal).*

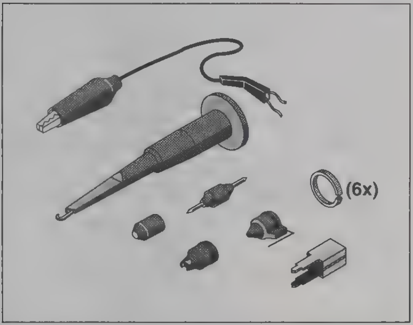
For detailed specifications on all probes refer to page 31.

Probe Accessory Sets

General accessory sets, clip sets and test leads for use with probes of the PM 9xx- family.

PM 9003/001

Accessory extension set for PM 90xx 10:1 and 1:1 probes, containing: dual test leads (2), short test leads (2), miniature grabber clips (2 red, 2 black), modular alligator clips (2) and modular ground leads long (2).

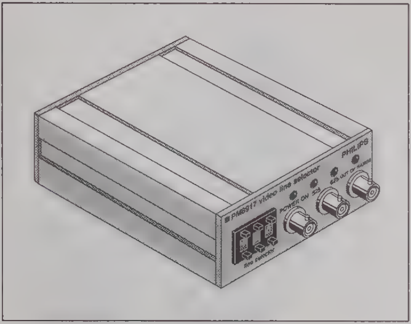


PM 9002/001

Replacement set of accessories for PM 90xx 1:1 and 10:1 probes containing: retractable hook tip, ground lead with alligator clip, color coding rings (6), insulation caps (2), bayonet ground contact spring, PCB connector and spare probe tip. PM 9002 is included with all PM 90xx probes.

PM 9102/001

Replacement set of accessories for PM 9100 100:1 probes, containing: retractable hook tip, ground lead with alligator clip, color coding rings (6), insulation cap, spare probe tip. PM 9102 is included with all PM 9100 probes.



PM 8917/00n Video Line Selector

Stand-alone signal processor used to separate the sync signal from a composite video signal of PAL or NTSC standard, to trigger an oscilloscope on any selected line.

Two BNC connectors are provided for feedthrough.

A third front panel mounted BNC is output of Line sync signal. Rear panel mounted BNC connectors provide TV Line sync and TV Frame or Field sync (switchable).

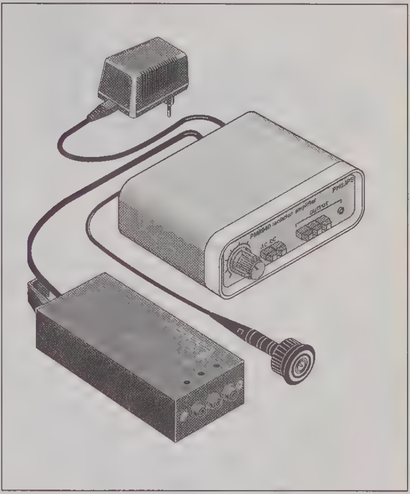
Selection of NTSC or PAL is automatic.

A thumb wheel switch permits selection of any video line to trigger a scope.

Technical Specifications

System: CCIR/FCC 525 line or CCIR/EBU 625 line system. Selection is automatic, and indicated by LED.
Input: 0.7V to 3V composite video
Impedance: 1 MΩ//30 pF; 75Ω when terminated with 75Ω
Maximum Input: 50V (dc + ac peak)
Outputs: TV Frame (Vert sync) or TV Field, TV Line, selected TV Line
Output Voltage: 1V p-p into 75Ω

Trigger Outputs
Frame Pulse: 0.5x frame width
Field Pulse: 1.8 µs
Line Pulse: 1.8 µs
Selected Line Pulse: 35 µs for line 0; 64 µs for all other lines
Power: 90V to 264V ac in one range, 45 Hz to 66 Hz, 7W



PM 8940/09n Isolation Amplifier

The PM 8940/09n is an isolation amplifier which permits small signals which may be present on high common mode voltages to be safely measured with oscilloscopes or other types of measuring devices.

The transfer sensitivity can be as high as 5 mV/div, depending on the PM 8940's attenuator setting, at the same time isolating and suppressing common mode voltages of up to 650V ac rms.

Isolation is obtained through the use of opto-isolation. The PM 8940/09n consists of two parts, permanently connected by a heat and chemical resistant cable.

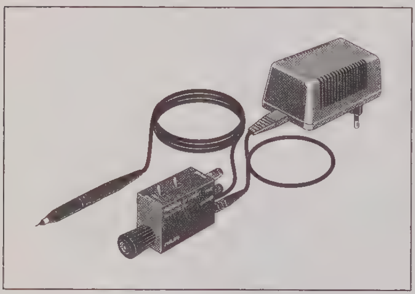
The actual input is made entirely of plastic and is battery operated, and has screw-type input terminals. It is the user's responsibility to connect the input signals to the inputs in a safe manner. Battery life is approximately 4 hours.

The "Control Box" provides controls for ac and dc coupling, as well as an input sensitivity switch and must be grounded to safety ground at all times.

Applications are in power electronics, SCRs, industrial electronics, utilities, transport companies, etc.

Technical Specifications

Frequency Response
DC Coupled: DC to 1.5 MHz (-3 dB)
AC Coupled: 3 Hz to 1.5 MHz (-3 dB)
Deflection Coefficient: 50 mV/div to 200V/div (HI), or 5 mV/div to 20V/div (LO)
Dynamic Range: 20 div at oscilloscope setting of 20 mV/div
Diff. Input Impedance: 10 MΩ//9 pF (HI); 1 MΩ//45 pF (LO)
Maximum Diff. Input Voltage: 650V rms
Common Mode Rejection: <= 0.5 div deflection with common mode of 650V rms, up to 60 Hz
Power: 115V ac or 220V ac (-10% to +20%), 45 Hz to 440 Hz, 10 VA



PM 8943A/00n 650 MHz FET Probe

The PM 8943A enables high frequency measurements, or measurements on systems with fast transient times and high source impedances, with no loss of input sensitivity and extremely low input capacitance at the probe tip. The PM 8943A can be used with all oscilloscopes, or counters, or any other type of measuring instrument having 1 MΩ or 50Ω input inpedances.

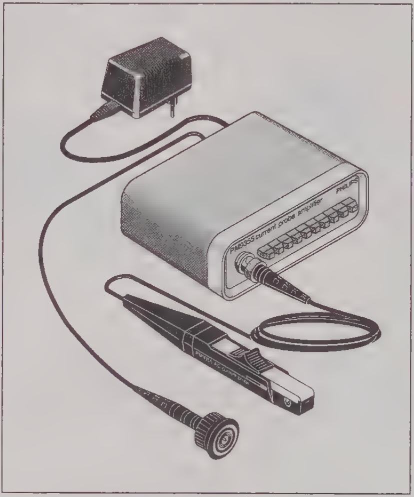
Technical Specifications

Frequency Range: DC to 650 MHz (-3 dB) with 50Ω termination (in ac position 1.1 Hz to 650 MHz)
Attenuation Factor: x1, x10, x100

Attenuator	**x1**	**x10**	**x100**
Dynamic Range:	±0.6V	±6V	±60V
Input Resistance:	1 MΩ	1 MΩ	1 MΩ
Input Capacitance:	3.5 pF	2.2 pF	1.4 pF
Offset Range:	±6V	±60V	±500V
Max Input Voltage:	±100V	±200V	±200V

Power: 120V or 220V (±10%), 45 Hz to 440 Hz, 10 VA. Power option depicted by letter n in the typenumber.

Note: The dynamic range of this FET probe is not affected by the amount of offset used.



PM 9355/09n AC Coupled Current Probe

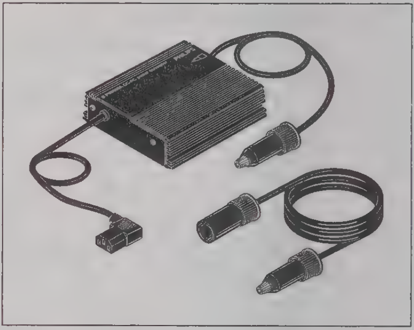
The PM 9355/09n provides a wide bandwidth and calibrated conversion from current signals to be measured into voltages to be accepted by an oscilloscope. It consists of a passive ac current sensing transformer, which plugs into an active amplifier/equalization circuit. The combination of these two guarantees a flat frequency response between 12 Hz and 70 MHz.

The amplifier section is equipped with its own sensitivity settings, calibrated in mA/div or A/div. To ensure proper calibration of the dimensions set on the PM 9355/09n, the oscilloscope input (with which it is used) must be set for a sensitivity of 20 mV/div.

With most Fluke oscilloscopes, this setting is automatically accomplished by the range indication on the BNC connector of the PM 9355/09n.

Technical Specifications

Maximum Wire Diameter: 3 mm
Frequency Response: ±12 Hz to ±70 MHz at 5 mA/div to 1 A/div; ±12 Hz to ±45 MHz at 1 mA/div and 2 mA/div
Sensitivity: 1 mA/div to 1 A/div (10 ranges in a 1, 2, 5 sequence). Scope input set at 20 mV/div.
Maximum Current: 12A p-p (for frequencies over 300 Hz). Derated to 1A at 100 Hz or lower.
Max Voltage on Conductor to be Measured: 600V (dc + ac peak) with probe closed
Dynamic Output Range: -6 div or +6 div (at >300 Hz within the limits of max input current)
Power: 110 or 220V ac (-10% to +20%), 45 Hz to 440 Hz, 10 VA



PM 8902A/001 DC to AC Converter

The PM 8902A provides the capability to run any of the Fluke oscilloscopes from a 12V dc supply.

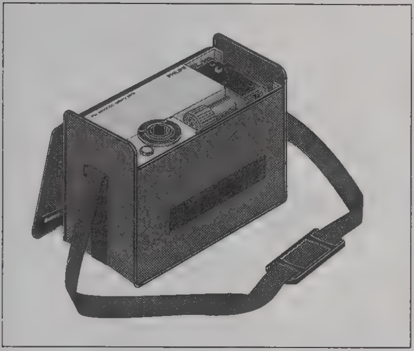
This highly compact and highly efficient converter has a 115V ac output which directly plugs into the power input connector at the rear of the oscilloscope.

Technical Specifications

Input Voltage: 10V dc to 15V dc
Low Battery Alarm: Audible alarm at ±10.7V dc
Maximum Current Drawn: 10A at output power of 100W
No Load Current Drawn: 70 mA
Output Voltage: 115V ac (rms), modified sine wave
Voltage Regulation: ±10% (for 11V dc to 14V dc input)
Output Frequency: 60 Hz ±0.1%
Maximum Continuous Output: 100W at -20°C to +50°C, 125W at -20°C to +40°C
Maximum Short Term Output: 400W surge 200W for 5 minutes maximum
Overload Protection: Electronic shut down at 70°C, restart at 65°C
Dimensions: 38 mm H x 115 mm W x 115 mm D (1.5 in H x 4.6 in W x 4.6 in D)
Connection to DC Source: Cigarette lighter plug
Supplied with Unit: 2m (6 ft) cigarette lighter extension cable and instruction manual

The n' indicates the required line cord. To select your line cord substitute the n' by:

1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz



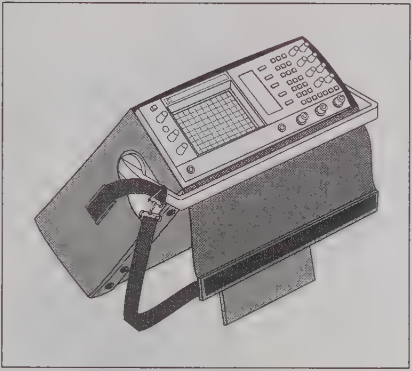
PM 8903/00n Battery Pack, Charger, Power Converter & Carrying Case

The PM 8903/00n gives Fluke oscilloscopes battery powered operation independent of any other power source. This complete set consists of the PM 8902A/001 dc to ac converter with a mounting strap to attach it to any Fluke oscilloscope, a 12V 15 Ah battery, battery charger, and carry case with shoulder strap.

Dimensions: 20 cm H x 30 cm W x 17 cm D (7.9 in H x 11.8 in W x 6.7 in D)
Weight: 10.2 kg (22.5 lbs)
Charging Unit V_{in}: 115/230V ac, 50 Hz to 60 Hz

Typical Operating Times

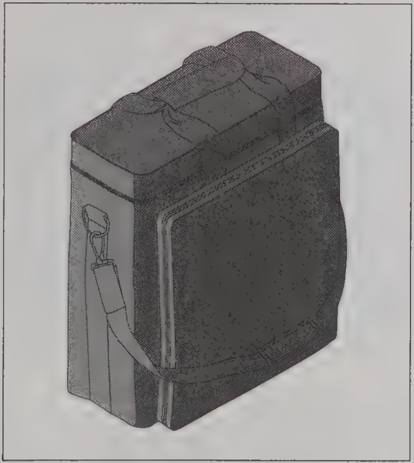
Analog		**CombiScope™**	
PM 3050	90 min.	PM 3335	75 min.
PM 3055	90 min.	PM 3350A	60 min.
PM 3065	75 min.	PM 3365A	55 min.
PM 3070	75 min.	PM 3355	50 min.
PM 3092	65 min.	PM 3375	45 min.
PM 3094	65 min.	PM 3382	55 min.
		PM 3384	55 min.
		PM 3392	45 min.
		PM 3394	45 min.



PM 8989/001 Traveller Carry Case

This rugged carry case provides protection of the oscilloscope during transport as well as during operation and provides storage for probes and manual. The integral shoulder strap enables the oscilloscope to be easily carried from location to location.

The oscilloscope can be used without removing it from the carry case and a tilt stand gives an ideal viewing angle when the oscilloscope must stand on the floor.

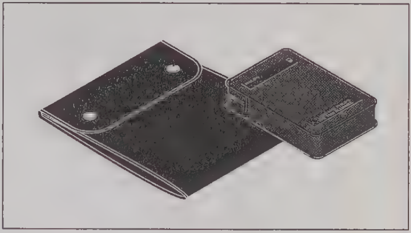


PM 8989/031 Traveller Carry Case

This rugged carry case provides protection for the oscilloscope and its accessories during transportation in inclement weather.

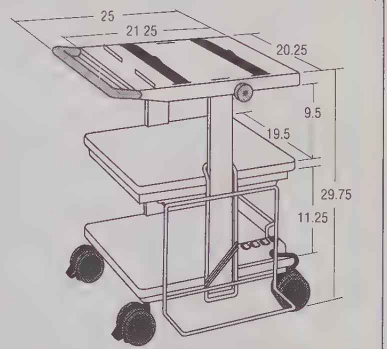
Ample space is provided for accessories and manuals.

The case has convenient straps for hand carry, a shoulder strap and an additional strap to carry it as a “ruck sack”.



PM 8992/801 Full Size Pouch
PM 8992/651 Half Size Pouch

Adds storage space to portable oscilloscope models for most frequently used accessories when the oscilloscope is used in portable, or field service applications.



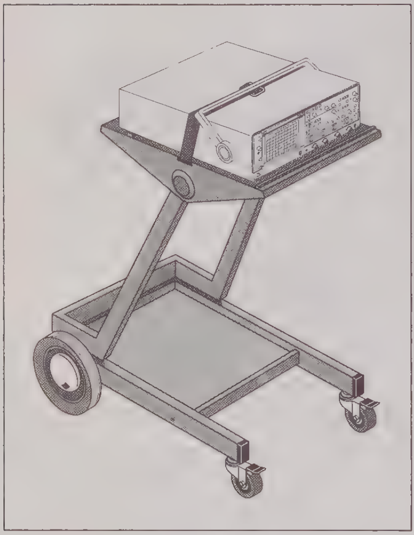
Measurements in inches

TC100 Instrument Transport Cart

The TC100 Instrument Cart provides three levels of work surface, each of which accommodates instruments up to 19" wide. It easily combines an oscilloscope or other instrument, with a printer and paper supply on one easily movable work station. The top shelf can be adjusted over an angle of 25°, and it has a safety lock. The cart has a capacity of 300 lb. Four casters, two of which can be locked, provide excellent mobility, and maneuverability. Options include a line power strip, accessories drawer, and a CPU bracket.

Drawer Size: 17.75" W x 19.5" D x 3" H
CPU Bracket Size: 15" W x 5.5' D x 17" H

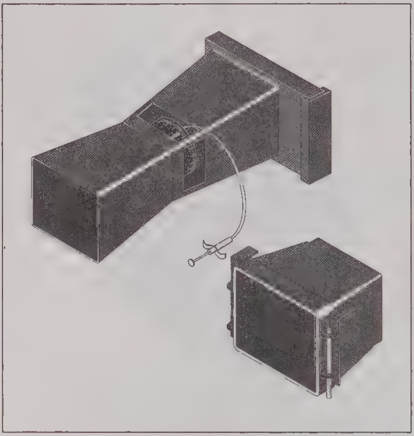
Accessories



PM 8991/04 Oscilloscope Cart

The PM 8991 provides oscilloscope support next to the lab table, and an easy way to move oscilloscopes around in labs, or factory floors.

With a large footprint for stability, and large wheels with roller bearings for smooth operation, easy movement over thresholds, cables etc. is realized. The front wheels have casters for maneuverability. The angle of the table is continuously adjustable between 15° downward to +70° upwards and once set is securely locked.



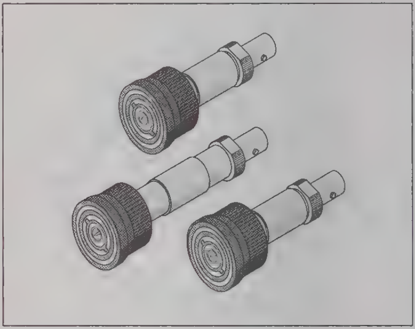
PM 9381 Polaroid® Camera

Camera system for instant photographic recording of oscillograms. It can be used as a handheld camera, or used with spacer body and oscilloscope bezel for fixed installation and longer exposure times.

Camera Specifications

Object to Image Ratio: 1: 0.85
Lens: 70 mm f/3.5
Shutter: Self-cocking, mechanical, 1 s to 1/125s and B; sync contact for event triggering
Film Back: Fixed, suitable for Polaroid type 107
Adapters Supplied: Handheld type and PM 8978/011

Optional Adapters for Fixed Use
For Philips Camera: PM 8978/011 for PM 3080, PM 3090 and PM 3380 and PM 3390 series oscilloscopes
For Tektronix Camera, Type C-5C and C-7: PM 8978/021 for PM 3080, PM 3090, PM 3380 and PM 3390 series oscilloscopes



PM 9591/091 10:1 50Ω to 50Ω Attenuator
PM 9596/091 100:1 50Ω to 50Ω Attenuator
PM 9598/091 10:1 75Ω to 50Ω Attenuator
PM 9599/091 Set of 3 Attenuators

These products provide attenuation of wide bandwidth VHF signals, with proper termination of 50Ω and 75Ω cables respectively.

Each attenuator has BNC male female connectors and 50Ω output.

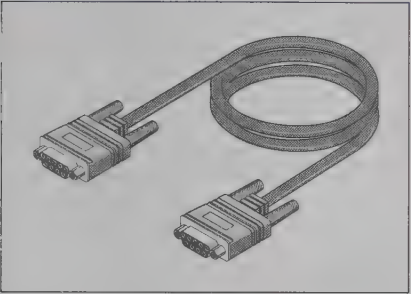
On Fluke oscilloscopes so equipped, the scale factor readout and input impedances are automatically set.

Attenuation: 10:1 for PM 9591/09 and PM 9598/09; 100:1 for PM 9596/09
Input Resistance: 50Ω for PM 9591/09 and PM 9596/09; 75Ω for PM 9598/09
Output Resistance: 50Ω
Maximum Input Voltage: 100V peak
Maximum Power Dissipation: 0.5W

Rack Mount Kits

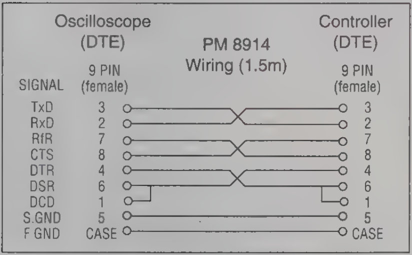
Oscilloscope Typenumber	Rack Mount Typenumber	Dimensions						
		Height			Length		Width	
		E	mm	in	mm	in	mm	in
PM 3050/55/65/70	PM 8969/001	3E	133.4	5.25	392	15.4	483	19
PM 3082/84/92/94	PM 8960/041	4E	177.8	7	481	18.9	483	19
PM 3335/50A/55/65A/75	PM 8969/001	3E	133.4	5.25	392	15.4	483	19
PM 3382/84/84E/92/94	PM 8960/041	4E	177.8	7	481	18.9	483	19
PM 3340	PM 8964/401	4E	177.8	7	variable		483	19

RS-232C Serial Communication Cables



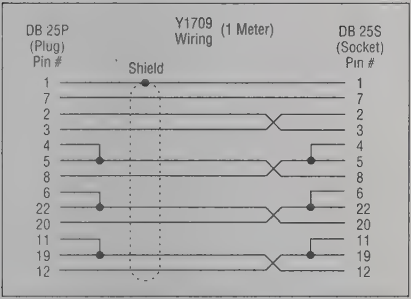
PM 8914/001 CombiScope Interface Cable

The PM 8914/001 CombiScope Interface Cable provides the RS-232 connection between a CombiScope and a PC. It is equipped with DB-9 female connectors on either side, fitting directly onto most PC serial busses. Cable length is 1.5m (5 ft). Cable wiring diagram is based upon the RfR protocol, providing a full seven wire connection and supporting hardware handshake.



Y1709 RS-232C Serial Printer Cable

Printer cable to make an RS-232 connection between an oscilloscope and a printer. Connectors are DB-25, one male and one female. Cable length 1m (2.5 ft).



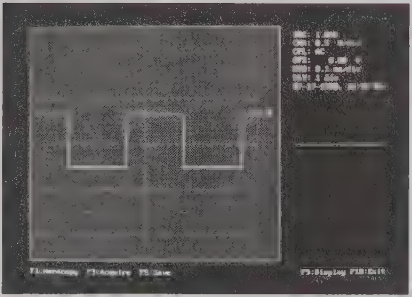
Software for CombiScopes™

The capabilities of the CombiScopes in this catalog can be greatly enhanced when used with computers. Fluke offers menu-driven software tools make CombiScopes quick to set up and use, and simple to program. So, whether you're looking for software to aid in fast and simple development and debugging of programs, or a package that allows full bi-directional communication between a CombiScope and PC over standard telephone lines, we have the right CombiScope software tools for the job.

PM 2255 First Class Instrument Drivers

GPIB system programming is simplified by the Fluke PM 2255 Instrument Drivers for PC-compatible and PS/2 computers. These drivers cover a wide range of specific Fluke instruments, including digital multimeters, signal generators, programmable power supplies, data acquisition, frequency counters and timers, oscilloscopes and switching systems. Also included in the PM 2255 Instrument Drivers are GPIB procedures to program instruments that are not supported by specific drivers. An auto-configuration utility automatically determines the GPIB system configuration, allowing the user to write the application program with the knowledge that the system is correctly configured. See page XXX for more details.

PM 2270 DSO COM



PC screen of captured waveform.

For users of the CombiScopes, mass storage of acquired waveforms on your PC is made easy by the PM 2270 communication software package. PM 2270 allows traces to be up- and downloaded simply between CombiScope and PC using an RS-232C link. Captured traces can then be displayed on the PC, together with the corresponding CombiScope settings, and stored on disk for instant recall at any time.

With this capability, post-processing of captured signal data from the CombiScope can be done using your favorite signal processing package. File naming and directory overview facilities make it easy to search for and identify particular files.

It is possible to store the graph on the PC screen as an HPGL file. Such a file can also be made with an exact image of the CombiScope screen, by transferring HPGL data from the CombiScope to the PC. With a number of word processors it is then possible to incorporate the graphical image in a document.

Ideal for use in research, labs, and maintenance, DSO COM can also be used with laptop computers in field research.

Supported CombiScopes with RS-232C Interface: PM 3335/3350A/3355/3365A/3375/3382/3384/3392/3394, and ScopeMeter 97

System Requirements

- IBM PC/XT/AT, PS/2 or compatible with serial interface
- 640K bytes of memory
- Floppy disk and one hard disk drive
- IBM CGA, EGA or VGA, or Hercules graphics adapter

PM 2273 AnyWave

The PM 2273 AnyWave is a PC software package that adds valuable automated test functionality to the CombiScopes. The program is used to create a test mask (also called test template) defined by upper and lower limit waveforms. The test mask provides a reference for all signals captured by the CombiScope, allowing instant, automatic pass/fail testing on captured signals using either RS-232 or GPIB/IEEE-488* interface.

On the supported CombiScopes, the test mask can be downloaded to the CombiScope which then performs the comparisons itself.

Easy Test Envelope Creation

Creation of the test masks is done easily, for example by shifting a captured signal in time and amplitude to define the upper and lower limit waveforms. Alternatively, waveforms can be edited using the PC's keyboard and mouse to create any desired test mask.

The ability of the PM 2273 AnyWave program to create waveforms can also be used together with an arbitrary/function generator (like the PM 5150, PM 5138, and PM 5139), which can then reproduce those exact waveforms whenever required.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

The PM 2273 AnyWave package also allows waveforms to be transferred from CombiScope to PC, for graphic display and archiving. When mask comparison is on, failing waveforms can be stored automatically. Stored waveforms can be used by other post-processing packages such as spreadsheet programs.

User-Friendly Operation

An oscilloscope graticule is always shown on the PC display, together with the oscilloscope setting and a menu bar. Commands can be executed simply by by clicking with the mouse.

Supported CombiScopes: PM 3335/3350A/3355/3365A/3375/3382/3384/3392/3394

System Requirements

- For IBM PC/XT/AT, PS/2 or compatible
- 640K bytes of memory
- Floppy disk and one hard disk drive
- PM 2201 or PM 2202 (MicroChannel) GPIB interface card or National Instruments GPIB interface card (optional)
- IBM EGA, or VGA, Hercules graphics adapter

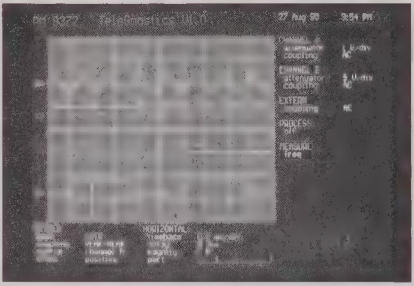
Ordering Information

PM 2273/01 AnyWave waveform creation and envelope creation software

PM 2201/98 GPIB interface for PC/XT/AT and PS/2 with PC bus

PM 2202/98 GPIB interface for PS/2 with MicroChannel bus

PM 9372 Telegnostics



Screen shot of on-line telephone connection with a CombiScope.

Telephone communication and support package for Fluke CombiScopes and ScopeMeter. As the use of complex, high-tech systems increases, so do service and repair challenges. The new TeleGnostics software package is ideal in service environments utilizing a central, highly trained group supporting mobile service engineers/technicians. It provides a direct telephone link between the on-site technician's CombiScope or ScopeMeter and a PC (or PC plus CombiScope for even more flexibility) at the service center.

Full Bi-Directional Communication of Set Ups and Signals

Full bi-directional communication allows transmission of complete set ups to the remote CombiScope, as well as reference waveforms for comparison purposes. Captured waveforms and measurements from the remote site can also be monitored on the local PC or CombiScope.

In other words, the technician at the service center gets a virtual 'on-line' capability to immediately view and analyze problems at the remote site.

If desired, waveforms from the remote site can be stored on the PC disk at the service center, for later detailed analysis or for regular performance logging.

Telegnostics allows measurement results to be transmitted with the CombiScope's full accuracy from the remote site to the service center. These can include data like voltage, current, temperature, pressure, flow rate, or any other parameters measured on-site.

Supported CombiScopes with RS-232C Interface: PM 3350A/3355/3365A/3375/3382/3384/3392/3394, Fluke 97 ScopeMeter and Hydra Data Acquisition Series 2620A/2625A

System Requirements

- IBM PC/XT/AT or 100% compatibles, with at least one serial port.
- Minimum 640K bytes of memory, one floppy, and hard disk drive
- IBM, EGA or VGA graphics adapter and monitor
- Hayes or 100% compatible modem
- Procomm Plus software version 2

Ordering Information

PM 9372/002 TeleGnostics application package, including 3.5" and 5.25" diskettes and instruction manual

ScopeMeter® Test Tools

NEW

Operating Software Upgraded to Version 4

Fluke 97 Page 50

NEW

Automotive Kit Page 55

Fluke 93 Page 50

What do you get when you combine the powerful easy-to-operate digital storage oscilloscope and the world's best digital multimeter? A ScopeMeter® test tool, of course, a truly integrated scope-and-multimeter from Fluke.

Imagine what you can do with a hand-held instrument that teams a dual channel, 50 MHz, 25 mega-sample per second digital storage oscilloscope with a feature packed 3000-count digital multimeter, all in a rugged, sealed industrial package with battery operation that you can take anywhere you go.

For the first time all your measurement requirements are covered in a single compact tool. From the first line service needs, like power levels and continuity testing, to advanced troubleshooting where waveform distortion and high speed timing analysis are needed, the ScopeMeter test tool covers them all. With the advantages of a digital storage oscilloscope you can capture, analyze, and store exactly the information you're after, and faster than ever before. Just a touch of the AUTOSET key and the ScopeMeter test tool automatically sets itself up.

And all the problems that elude a conventional oscilloscope or multimeter can now be caught with the ScopeMeter test tool. Single shots, transients, power spikes, hidden glitches, or low speed phenomena are now instantly visible.

Select from three different models – one just right for your job. Notice they all come with a complete set of accessories, a hassle free three-year warranty, and a price tailored to put you in business within your budget.

The ScopeMeter test tool. Now there's only one to reach for.

ScopeMeter Test Tools Page 50
Selection Guide Page 54
Automotive ScopeMeter Test Tools Page 55
Accessories Page 56

ScopeMeter® Test Tools

90 Series

Available through Distributors

RS-232

LISTED
UL
1244

Fluke 93

LISTED
UL
1244

Fluke 95

LISTED
UL
1244

Fluke 97

Fluke 90 Series ScopeMeter® Test Tools
Scope, meter, or simultaneous meter and scope display
Dual channel 50 MHz Digital Storage Oscilloscope
25 megasamples/second, 40 nanosecond glitch capture
10 front panel setups plus 8 waveforms with setup memories
NEW 15 cursor measurements
3000 count Digital Multimeter with Touch Hold®
True ac or ac+dc rms measurements to 5 MHz
NEW Full four digit Counter
NEW Min Max Average recording mode with Time Stamp
Optically isolated RS-232 interface (97 only)
Rugged, sealed case weighs 1.8 kg (4 lbs) incl. battery

The ScopeMeter® test tool is the first truly integrated scope-and-multimeter that lets you see the scope waveform, or the digital meter readout, or both at the same time and from the same input. Or switch between dedicated high-performance scope and meter functions with the touch of a key.

The ScopeMeter test tools' intuitive front panel layout is simple and straight forward. Every key is clearly labeled. Five soft function keys and pop-up menus give you fast, confident control of all your options. The high resolution LCD display (backlit on model 97) is bright and crisp, presenting fully detailed waveform information, or digits large enough to see across the room.

In the scope mode AUTOSET and powerful cursor capabilities take all the work out of signal acquisition and measurements. Deep memories allow you to store and recall up to eight waveforms, and compare up to four waveforms on screen. In addition, up to 10 instrument setups can be saved for routine measurements.

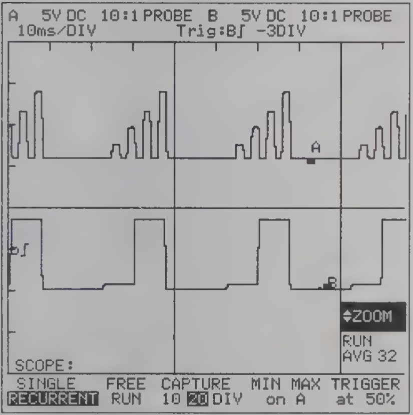
The multimeter capability gives you all the convenience features you've come to expect from Fluke – autoranging, Touch Hold®, Min Max Average recording, audible continuity, frequency counter and more. In the combined meter and scope display mode the scope trace is fully automatic, you don't have to adjust any amplitude, time, or trigger function. Just connect the signal and see both numeric and trace results.

There's even a signal generator that can produce square waves at three different frequencies, a sine wave or current and voltage ramps for testing components.

The ScopeMeter test tool is truly portable, weighing just 1.8 kg (4 lbs.) including its rechareable battery that gives four hours of test time away from ac power. All three models are sealed against water, dust and contaminants, and shielded from EMI. All models use the same input for both scope and meter measurements enabling safe scope analysis of signals up 600V rms (with PM 8918 probes). The ScopeMeter test tool is UL listed.

Powerful DSO Performance

With dual channel 50 MHz bandwidth you can digitize and store the fastest repetitive signals. For single shots the 25 megasample per second acquisition rate gives 40 nsec resolution. At low sweep speeds, or in the roll mode the Min Max glitch capture function detects transients as short as 40 nsec. Add true 8-bit vertical resolution, a broad range of clever triggering capabilities, and a roll mode for low frequency signals and you have a comprehensive and powerful DSO.


A 5V DC 10:1 PROBE B 5V DC 10:1 PROBE
10ms/DIV Trig:B∫ -3DIV
A
B
◆ZOOM
RUN
AVG 32
SCOPE:
SINGLE
RECURRENT
FREE RUN
CAPTURE 10 20 DIV
MIN MAX on A
TRIGGER at 50%

AUTOSET for Instant Scope Display

Just a touch of the AUTOSET key and the ScopeMeter test tool sets its own triggering, time and amplitude scaling to give a stable display in just a second. This time saving feature makes setup on even complex signals fast and simple.

See Signals Before and After Trigger

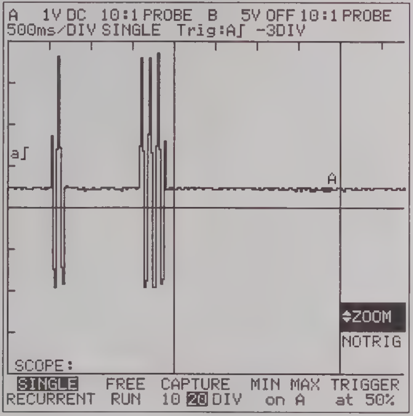
The ScopeMeter test tool lets you capture 20 divisions of information that precede to the trigger event (pre-trigger) so you can see the cause and the result. To check if a sequence runs correctly after a trigger event the post trigger capability enables delays of up to 640 divisions to be set in steps of one division.

Zoom in on Detail

Need to see more signal detail? Then just locate the area of interest at the center of the screen and press the ZOOM softkey. Up to 1000x magnification of the signal detail is possible with automatic adjustment of sweep speed and trigger delay.

Eliminate or Detect Noise on Signals

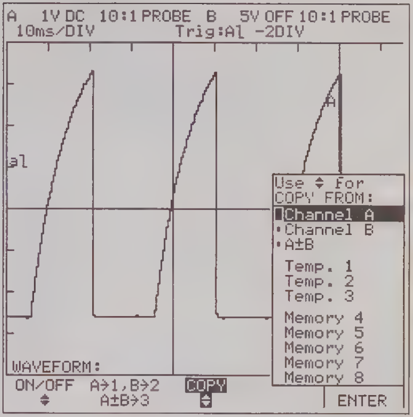
Occasionally its difficult to see the real signal because of the noise on it. The Averaging mode averages the incoming signal over multiple acquisitions to eliminate the noise and make clearly visible the real signal.


A 1V DC 10:1 PROBE B 5V OFF 10:1 PROBE
500ms/DIV SINGLE Trig:A∫ -3DIV
a∫
A
◆ZOOM
NOTRIG
SCOPE:
SINGLE
RECURRENT
FREE RUN
CAPTURE 10 20 DIV
MIN MAX on A
TRIGGER at 50%

Sometimes noise is the cause of a problem. Using Min Max glitch capture transients as short as 40 nsec are revealed. Select Record mode and all variations captured in previous acquisitions are retained on screen making it an ideal baby-sitting mode for intermittent problem solving.

Rolling Display for Slow Signals

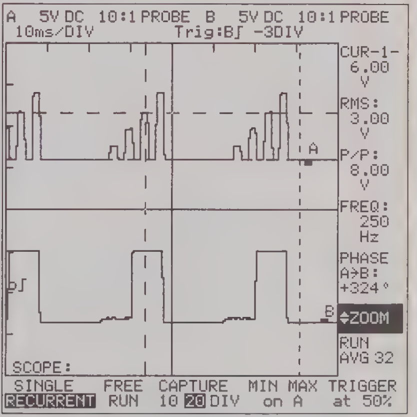
Here the display "rolls" across the screen at time base speeds as slow as 60 sec/div. Roll is like a pen recorder, directly showing what's happening now, and what occurred in the immediate past. Ideal for slow signal tracking.


A 1V DC 10:1 PROBE B 5V OFF 10:1 PROBE
10ms/DIV Trig:A⌉ -2DIV
a⌉
A
Use ◆ for
COPY FROM:
Channel A
Channel B
A±B
Temp. 1
Temp. 2
Temp. 3
Memory 4
Memory 5
Memory 6
Memory 7
Memory 8
WAVEFORM:
ON/OFF ◆
A→1, B→2 A±B→3
COPY ◆
ENTER

Waveform and Setup Memories

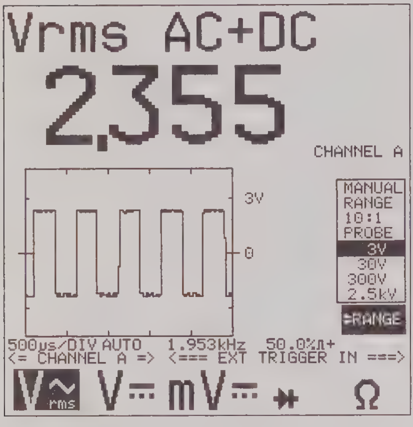
The ScopeMeter test tools 8 waveforms with setup memories store reference signals with their setup. Just recall them for fast comparative verification, or use them to store waveforms for later analysis.

The 10 additional setups recall your standard test configurations at the touch of a key. It's a lot faster than having to set them up every time.


A 5V DC 10:1 PROBE B 5V DC 10:1 PROBE
10ms/DIV Trig:B∫ -3DIV
CUR-1- 6.00 V
RMS: 3.00 V
P/P: 8.00 V
FREQ: 250 Hz
PHASE A→B: +324°
A
B
◆ZOOM
RUN
AVG 32
SCOPE:
SINGLE
RECURRENT
FREE RUN
CAPTURE 10 20 DIV
MIN MAX on A
TRIGGER at 50%

Cursors and Math for Processed Results

Fifteen cursor measurements give immediate readout of frequency, rise time, etc. without having to count divisions and make calculations. Math functions enable signals to be added, subtracted, inverted, multiplied, integrated or filtered to extract exactly the information you need to know.



Multimeter Performance

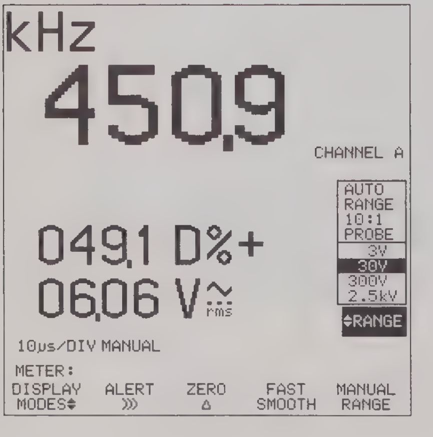
Direct measurements include voltage to 250V rms ac and 300V dc in four ranges. The included safety-designed detachable 10:1 probes extend voltage measurements to 600V rms (1700V peak-to-peak) for both oscilloscope and meter modes. Resistance measurements are in seven ranges from 30 ohms to 30 megohms. All readings are displayed with more than 3000 count resolution, and autoranging is standard.

AC and AC+DC RMS to 5 MHz

True ac and ac+dc rms voltage measurements are directly possible from dc to 5 MHz. This incredibly wide range makes simple yet accurate measurements in applications which elude even dedicated ac meters.

Full 4 Digit Counter

With four full digit resolution the autoranging counter function in the meter mode gives precise readouts, for example, line frequencies with 0.01 Hz resolution.



Multiple Meter Readout

Up to three parameters can be measured and displayed simultaneously. For example V ac rms plus frequency plus duty cycle give you all the relevant parameters of a P.W.M. motor drive in a single glance.

Min Max Average Recording with Time Stamp

Hook up the ScopeMeter test tool, switch on this mode and go about your other business. When you come back, be it minutes or days later, you see the maximum, minimum, average and present reading with their respective times.

You can also switch on Min Max Alert™ which emits an audible tone every time a new Max or Min is detected, very useful when your working on something else at the same time.

Touch Hold, Relative Mode, dB

Just like all Fluke meters the ScopeMeter test tool includes all the facilities to make meter measurements fast and efficient. Touch Hold captures a stable measurement, beeps and locks on the display until you're ready to view it – updating automatically with each new test.

The Relative Mode measures the difference between the present signal and previously measured reference.

Direct readout of dBm, dBV, dBW, and Audio Watts relative to a selected impedance is also possible.

Shock Protection

The ScopeMeter test tool's double insulated case, rugged input measuring circuits, and safety-designed BNC input connectors and probes meet the high safety levels specified for power distribution circuits up to 600V 3 phase. This includes double insulation per UL, CSA, and International standards and surge protection up to 6 kV spikes per ANSI/IEEE C62.41.

Hard Copy and Remote Control

Optically isolated RS-232 makes hard copy or remote control both simple and safe. (Optional cable PM 9080/001 required). Connecting to HP Thinkjet and Epson FX/LQ compatible serial printers, screen dumps, waveforms or numeric data can be hard copied.

In conjunction with a PC, meter and scope cursor measurement readout, as well as setup and waveform transfer to and from ScopeMeter is possible.

Function Generator

The ScopeMeter test tool produces four different test signals: square wave, sine wave, voltage ramp or current ramp.

Specifications

Oscilloscope Specifications

Vertical

Frequency Response, -3 dB: DC to >50 MHz
AC Coupled: <10 Hz direct, <1 Hz with 10:1 probe
Rise Time: <7 ns
Sensitivity: 1 mV to 100V/division (95/97 only); 5 mV to 100V/division (93 only), 200V, 500V, or 1 kV/division with 10:1 probe (all models)
Modes: Channel A, A inverted, B, B inverted, A+B, A-B, or A=y & B=x
Input Impedance: 1 MΩ, 25 pF direct; 10 MΩ with 10:1 probe
Resolution: 8 Bit A/D Converter
Accuracy: ±(2% + 1 pixel)
Cross Talk: <-40 dB at 50 MHz

Horizontal

Modes: Recurrent, Single Shot, Roll

Ranges
Recurrent: 10 ns to 5s/division
Dual Channel Alternating: 10 ns to 20 µs/division
Dual Channel Chopped: 50 µs to 5s/division

Single Shot: 100 ns to 5s/division
Dual Channel Alternating: 100 ns to 20 µs/division
Dual Channel Chopped: 50 µs to 5s/division
Roll (dual channel chopped): 10s to 60s/division

Accuracy: ±(0.1% + 1 pixel)
Record Length: 512 samples (pixels), 20.48 divisions, or 256 samples, 10 divisions

Trigger

Sources: Channel A, B, or External
Slope: + or - Edge

Sensitivity
Channel A or B: <0.8 division to 10 MHz; <1.5 division to 60 MHz; <4 divisions to 100 MHz
External: +0.2V or +2V level (TTL compatible)
Input Impedance: 1 MΩ 25 pF direct; 10 MΩ with 10:1 probe

Digital Delay
Time: -20 to +640 divisions
N-Cycle: After 2 to 255 trigger cycles (95/97 only)
Events: 1 to 1023 events after external trigger(95/97 only)

Waveform Average

Up to 256 waveforms, 10 samples in Roll mode (95/97 only)

Cursors

Display up to 5 measurements from user defined portion of waveform: voltage at cursor 1, dV, dt, frequency, 1/dt (equivalent frequency), maximum, minimum, peak-to-peak, rms, average (mean), phase, rise or fall time, time from trigger to cursor, or ratio (% change) (95/97 only)

Markers

Automatically indicate points on waveform used for peak-to-peak, maximum peak, minimum peak, frequency, risetime, or phase measurements (95/97 only)

Mathematics

Add, Subtract, Multiply, Filter, Invert, or Integrate Waveforms (97 only)

Memories

Waveform: Store 8 waveforms, 20 divisions deep (front panel setups used can also be recalled) (95/97 only)
Setup: Store 10 additional front panel setups (97 only)

Min Max Glitch Capture (95/97 only)

Time-Base Setting: ≥1 µs
Pulse-Width Capture: 100% probability for glitches or pulses >40 ns

Record Mode

Variable persistance display mode, selectable at 2, 5, 10 and 60 seconds, or infinite time

Zoom

Automatically selects time/division & time delay required to magnify waveform at center of display (95/97 only)

Multimeter Specifications

DC Voltage & mV

Ranges
Channel A Input: 300.0 mV, 3.000V, 30.00V, 300.0V (600V with PM 8918 10:1 probe)
mV (External Trigger) Input: 300.0 mV, 3.000V

Resolution: 0.1 mV, 1 mV, 10 mV, 100 mV and 1V
Accuracy: ±(0.5% + 5 counts)
Full Scale Reading: >3000 counts
Peak Voltage: 2.5 x Full Scale, 375V on 300V range
Normal Mode Rejection: >60 dB @ 50 or 60 Hz
Common Mode Rejection: >100 dB @ dc, 50, 60 or 400 Hz

AC or AC+DC True RMS Voltage

Ranges: 300.0 mV, 3.000V, 30.00V, 250.0V (600V with PM 8918 10:1 probe)
Resolution: 0.1 mV, 1 mV, 10 mV, 100 mV and 1V

Accuracy
50 Hz to 60 Hz: ±(1% + 10 counts)
20 Hz to 20 kHz: ±(2% + 15 counts)
5 Hz to 1 MHz: ±(3% + 20 counts)
DC to 5 MHz: ±(10% + 25 counts)

Accuracy valid from 5% to 100% of range

Full Scale Reading: >3000 counts
Peak Voltage: 2.5 x Full Scale, 375V on 250V range
Common Mode Rejection Ratio: >60 dB, dc to 60 Hz

Resistance

Ranges: 30.00Ω, 300.0Ω, 3.000 kΩ, 30.00 kΩ, 300.0 kΩ, 3.000 MΩ, 30.00 MΩ
Resolution: 0.01Ω, 0.1Ω, 1Ω, 10Ω, 100Ω, 1 kΩ, 10 kΩ
Accuracy: ±(0.5% + 5 counts) 30Ω ±2.5% + 25 counts
Measurement Current: 500 µA, 70 µA, 7 µA, 700 nA, 70 nA, 70 nA
Open Circuit Voltage: <4V
Full Scale Voltage: <250 mV to 3 MΩ, <2V to 30 MΩ
Full Scale Reading: >3000 counts

Diode Test

Open Circuit Maximum Voltage: 4V
Full Scale Maximum Voltage: 2.800V
Measurement Current: 500 µA

Additional Multimeter Modes

Frequency: 1 Hz to 5 MHz, ±(0.5% + 2 counts)
Duty Cycle: From <2% to >98% for signal amplitudes >10% of the input voltage range (±0.5% for logic or pulse waveforms)
Smoothing: Moving average of readings for last 6 seconds
Change Alert™: Audible beep when reading changes >50 counts
Relative (Δ): Zeros display on present or recorded reading
Touch Hold: Automatically captures each new reading, beeps and locks it in the display
%Change: Percent change from a reference reading (95/97 only)
%Scale: Percent of user selected start and end readings (95/97 only)
dBV: (95/97 only)
dBm: (Selectable reference of) 50, 60, 75, 93, 110, 125, 135, 150, 250, 300, 500, 600, 800, 900, 1000 or 1200Ω (95/97 only)
dBW or Audio Watts: (Selectable reference of) 1, 2, 4, 8, 16, or 50Ω (95/97 only)
Min Max Record: Simultaneously displays the present, maximum, minimum, and average readings (95/97 only) and Time Stamp

Signal Generator Specifications (97 only)

Sine Wave: 1V peak-to-peak @ 976 Hz with <3% distortion
Source Resistance: 400Ω

Square Wave: 5V peak-to-peak (±2.5V) @ 488 Hz, 976 Hz, or 1.95 kHz
Source Resistance: 400Ω

Component Tester

Current Mode: 0 to +3 mA in 128 discrete steps, 4 seconds total
Voltage Compliance: ≥2V

Voltage Mode: -2V to +2V in 128 discrete steps, 4 seconds total
Current Compliance: ±1 mA

General Specifications

The accuracy of all measurements are within ±[%(of reading) + (1 least significant digit)] from 18°C to 28°C. Add 0.1 x (specified accuracy) for temperature <18°C or >28°C ambient.

Display

Super Twisted Liquid Crystal
Size: 4.7 in. diagonal (84 X 84 mm)
Resolution: 240 x 240 pixels, 25 pixels/division
Contrast: User adjustable viewing angle
Backlight: Electroluminescent (97 only)

Power Supply

Internal Battery Pack: NiCad, 4.8V
Operating Time: 4 hours typical

Line Voltage Adapter/Battery Charger: Standard
Charging Time: 16 hours typical

Alternate Battery: 4 alkaline C cells (user supplied, not rechargeable)
External DC Charging Supply: 8V to 20V dc, 5 Watts typical (user supplied using a 5 mm power plug)

Environmental Data

Temperature
Operating: 0°C to 50°C
Storage: -20°C to 70°C

Humidity
Operating: 20°C to 30°C, 90% RH (non-condensing); 30°C to 50°C, 70% RH (non-condensing)
Storage: 95% RH

Altitude
Operating: 10,000 feet (3 km)
Storage: 40,000 feet (12 km)

Shock & Vibration: Per MIL-T-28800 for class 3
Electro-Magnetic Interference: Per MIL-STD-461 to 1V/meter
Safety: Designed to Class II per IEC 348 and UL 1244 listed for 600V measurements on industrial power distribution circuits

Overload Protection
Channel A or B Input: 300V rms, 600V rms with PM 8918 10:1 probe
Surge Protection: 4 kV, 6 kV with PM 8918 10:1 probe (per IEC 664, and ANSI/IEEE C62.41 test method)

External Trigger, Resistance, Diode Test, or DC mV Input: 600V rms

Maximum Voltage Isolation to Earth: 600V rms from any terminal

RS-232C Interface: Optically isolated
Full Remote Control: Also Epson FX/LQ or HP ThinkJet compatible, print: screen, waveform data points, or log meter readings (97 only) (PM 9080/001 required)
Calibration: All models have closed case calibration

90 Series

Mechanical Data

Size: 60 mm H x 130 mm W x 260 mm L (2.4 in H x 5.1 in W x 10.2 in L)
With Holster: 65 mm H x 140 mm W x 275 mm L (2.5 in H x 5.5 in W x 10.8 in L)

Weight: 1.5 kg (3.3 lbs)
With Holster: 1.8 kg (4.0 lbs)

Ordering Information

Models

Fluke 93 50 MHz ScopeMeter Test Tool
Fluke 95 50 MHz ScopeMeter Test Tool
Fluke 97 50 MHz ScopeMeter Test Tool

Included with Instrument

Three-year product warranty, NiCad battery pack (PM 9086/001), line voltage adapter/battery charger (PM 8907/003), probe set (PM 8918/002), dual banana plug to female BNC adapter (PM9081/001), yellow protective holster (PM 9083/001), accessory case (C75), multimeter test lead set, probe tip to banana plug adapter, Quick Operating Guide, Operator manual, and Certificate of Calibration Practices.

Accessory Recommendations for Measurements >42V Peak (30V RMS)

Similar to a safety-designed multimeter but unlike a conventional oscilloscope, the ScopeMeter test tool input connectors have no exposed metal and are fully insulated to protect against electrical shock. The ScopeMeter test tool COM (common) inputs (Channel A red BNC shield, Channel B grey BNC shield, and black banana jack) are connected internally via self-recovering fault protection. Any voltage on one COM input will be present on all COM connections.

To avoid risk of electrical shock, use only the following accessories when a ScopeMeter test tool COM input is connected to >42V peak (30V rms):

AC20, AC80, PM 8907/003, PM 8907/008, PM 8918/002, PM 8918/202, PM 9080/001, PM 9081/001, PM 9082/001, PM 9084/001, PM 9085/001, PM 9087/002, PM 9090/001, PM 9094/001, PM 9266/04 (Fluke 916015), TL20, TL75

Other ScopeMeter test tool compatible accessories are only suitable when the ScopeMeter test tool COM input is connected to an earth ground potential or <42V peak (30V rms).

Fluke 90 Series ScopeMeter Test Tool Selection Guide

	97	95	93
Bandwidth	50 MHz Dual Channel		
Sample Rate	25 Megasamples/second		
Autoset	Automatically sets Voltage, Time & Trigger		
Multimeter Display	$3^2/_3$ Digits (> 3000 Counts)		
True RMS Volts	AC or AC+DC up to 600V (1700V Pk-Pk)		
Resistance	30Ω to 30 MΩ		
Diode Test	Up to 2.8V		
Continuity Beeper	Yes		
Time/Division	10 ns/div to 60 sec/div		
Volts/Division	1 mV/div to 100 V/div		5 mV/div to 100 V/div
Digital Delay or Pre-Trigger	By Number of Cycles, Events, Time, or Zoom Mode		By Time
Special Multimeter Modes	Min Max Average Record with Time Stamp, Relative (zero), dBm, dBV, dBW, Audio Watts, %Scale, Frequency, %Duty Cycle, Smoothing™, Change Alert™		Frequency, %Duty Cycle, Smoothing™, Change Alert™
Oscilloscope Cursors	15 Measurements, Display 5 Simultaneously		
Glitch Capture	≥40 ns		
Waveform Processing	Average, Min Max, Record, Variable Persistence		
Waveform Memory	Store & Recall 8 Waveforms		
Set-Up Memory	Store & Recall 10 Front Panel Set-Ups		
Waveform Mathematics	Add, Subtract, Multiply, Invert, Filter or Integrate Waveforms		
Signal Generator Output	Sine wave or Square wave		
Component Tester Output	Voltage or Current Ramp		
Optically Isolated RS-232C Interface*	Full Operation by Remote Control		
Printer Output*	Serial		
Backlit Display	Electroluminescent		

** Requires optional PM 9080/001 interface cable*

General Accessories (Also see Section 7)

80i-410* DC/AC Clamp-on Current Probe
80i-1000S AC Current Oscilloscope Probe
80i-1010* DC/AC Clamp-on Current Probe
80i-kW* Clamp-on Current/Power Probe
C75 Accessory Case
C95 Soft Carrying Case
C97 Hard Carrying Case
PM 8906/003 Fast Battery Charger (3 hrs)
PM 8907/003 Adapter/Battery Charger
PM 8907/008 Universal Adapter Charger
PM 9083/001 Protective Holster
PM 9086/001 NiCad Battery Pack
PM 9087/001 Automotive Lighter Plug Charging Adapter
PM 9094/001 Accessory Set for Probe
Y8100* DC/AC Current Probe

**262XA-801 Diconix 80-column Serial Printer*

Accessories Safety Designed for Electrical or Isolated Electronic Measurements

AC20 Industrial Alligator Clip
AC80 Hook-Style Clip
PM 8918/002 Probe Set (1.5m, 5 ft)
PM 8918/202 Probe Set (2.5m, 8 ft)
PM 9080/001 RS-232C Optical Interface Adapter Cable
PM 9081/001 Dual Banana Plug to Female BNC Adapter
PM 9082/001 Dual Banana Jack to Male BNC Adapter
PM 9084/001 Probe Industrial Alligator Clip
PM 9085/001 Probe Industrial Hook-Style Clip
PM 9090/001 Probe Pin Grabber Flexible Clip
PM 9091/001 Male BNC to Male BNC Cable Set (1.5m, 5 ft)
PM 9092/001 Male BNC to Male BNC Cable Set (0.5m, 1.5 ft)
PM 9093/001 Male BNC to Dual Female BNC Adapter
PM 9095/001 Single Banana Jack to Male BNC Adapter
PM 9266/041 Silicone Test Lead Set
TL20 Industrial Test Lead Set
TL75 Right Angle Test Lead Set

Accessories Designed for Non-Isolated, Grounded Electronic Measurements

80J-10 Current Shunt
80T-150U Temperature Probe
PM 9001/001 Probe Set 1:1, (1.5m, 5 ft)
PM 9001/201 Probe Set 1:1, (2.5m, 8 ft)
PM 9003/001 Probe Accessory Set
PM 9011/001 Switchable Probe Set 1:1, 10:1 (1.5m, 5 ft)
PM 9100/001 Probe Set 100:1, (1.5m, 5 ft)
PM 9355/09n AC Current Probe

97/AUTO

Available through Distributors

97/AUTO

Fluke 97/AUTO ScopeMeter Automotive Test Tool

- Training and support includes a self-paced training package with video, manual, waveform directory, and signal simulator
- Hard carrying case for storage and transport of instruments and accessories
- Accessories supplied include silicone rubber test leads, wide jaw alligator clips, stainless steel test probes, banana jack/BNC adapter, banana jack/break out box adapter, back-probe pins
- True portability and battery power make it ideal for quick road tests
- Internal rechargeable batteries; line power adapter/battery charger; isolated 12V power adapter
- Clean, clear presentation of signals, including pulse trains, on large backlit display
- Cursors for precise values of complex signals such as injector on-times
- Glitch capture reveals even the fastest intermittent malfunctions - the ScopeMeter test tool is thousands of times faster than any automotive electrical occurrence
- Inductive pickup for external triggering (North American version)

Finding and fixing the electrical bugs that plague today's automobiles can be frustrating and costly. It requires a whole new set of skills. Plus a tool that does high-speed recording to show "snap shots" of what's really happening in those wires, sensors and controls. That's the 97/AUTO ScopeMeter® test tool, and it provides a better, faster, more profitable way to troubleshoot automotive electronics.

The 97/AUTO opens a window into an automobile's electrical system and lets you "see" problems not identified by trouble codes. 97/AUTO ScopeMeter test tool can capture a circuit's live "signature" and store it for later analysis or comparison against known-good waveforms - an invaluable resource for detecting marginal components. The ScopeMeter test tool represents the most powerful and versatile tool available for tracking down elusive no-code driveability problems.

The 97/AUTO ScopeMeter test tool comes as a comprehensive diagnostic package - including the instrument, test leads, probes and clips, inductive pickup, a rugged carrying case to keep it all together, plus a comprehensive training package.

Accessories allow extended diagnostic capabilities, such as pressure, vacuum, temperature, current and secondary ignition measurements. An optional interface cable is available for printing hard copies or downloading to a PC.

The 97/AUTO ScopeMeter test tool kit is not available in certain countries, and its actual content varies from country to country dependent on local requirements.

Fluke 97/AUTO ScopeMeter Test Tool Standard Kit Configuration

(for U.S. market)

- Fluke 97/AUTO ScopeMeter test tool (North American version)
- Protective Holster
- Inductive Pickup for external trigger
- Rechargeable NiCad battery pack
- 120V/230V power adapter/battery charger
- Isolated automotive power adapter
- Hard Carrying Case (for instrument and accessories)
- Soft Case (for accessories and test leads)
- Silicone rubber test leads
- Wide jaw alligator clips
- Stainless steel test probes
- Banana jack/BNC adapter, banana jack/break out box adapter, back-probe pins
- User's Manual
- Three-year warranty (ScopeMeter test tool), one-year warranty (Accessories)
- Self-paced training package, including training manual, video, waveform signal simulator, and waveform directory

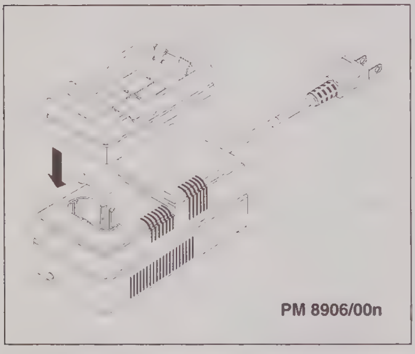
Accessories

PM 8907/00n

PM 8907/00n Line Voltage Adapter/Battery Charger

Provides power cord operation and charging for 90 Series ScopeMeters.

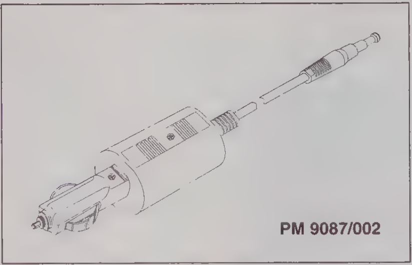
Line Voltages: 230V ±10%, or 115V ±10%, or switchable 115V and 230V ±15%
Frequency (All Versions): 50 Hz to 400 Hz
Output Voltage/Current: 15V/300 mA max
Power Consumption: 5W max
Maximum Voltage to Ground: 600V acc. to IEC 1010-1


PM 8906/00n

PM 8906/00n Fast NiCad Battery Pack Charger (3 Hrs)

Fast charger for battery pack PM 9086 battery pack (adapter included) or 4 NiCad size C batteries. LED indication of charging process.

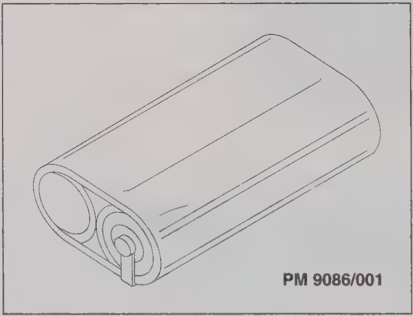
Line Voltages: 115V ±15%, or 230V ±15%
Frequency (Both Versions): 50 Hz to 400 Hz ±10%
Output Current: 1A max
Power Consumption: 8W max


PM 9087/002

PM 9087/002 Isolated Automotive Lighter Plug Charging Adapter

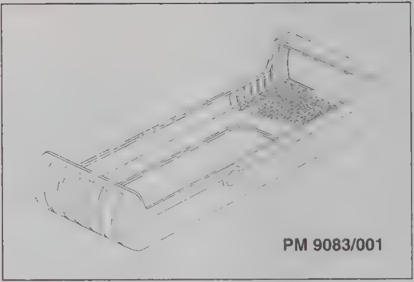
This adapter enables a 90 Series ScopeMeter to be charged or operated from an automotive lighter socket. The input and output are double isolated up to a maximum signal voltage of 125V (acc. IEC 1010-1) which isolates the ground of the ScopeMeter from the car battery (chassis) ground. The input is also fused to prevent fire or accidental damage to the device.

Input Voltage: 8V dc to 15V dc
Output Voltage: 12V dc ±10%
Output Current: 400 mA max
Power Consumption: 5W max
Isolation Voltage: 150V input to output
Cable Length: 2m (6.5 ft)


PM 9086/001

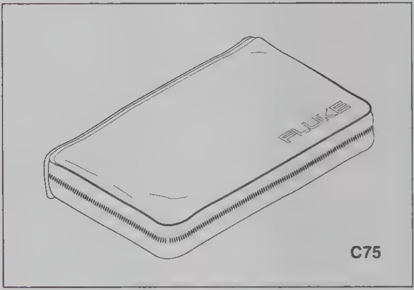
PM 9086/001 NiCad Battery Pack

Designed for use with 90 Series ScopeMeters. This pack consists of 4 NiCad batteries having a nominal voltage is 4.8V with a capacity of 2.2 Ah.


PM 9083/001

PM 9083/001 ScopeMeter Yellow Protective Holster

Made from a durable semi-flexible plastic, it snaps around the ScopeMeter to give protection from rough handling. It provides storage of the Quick Operating Guide and all tilt stand positions are maintained.

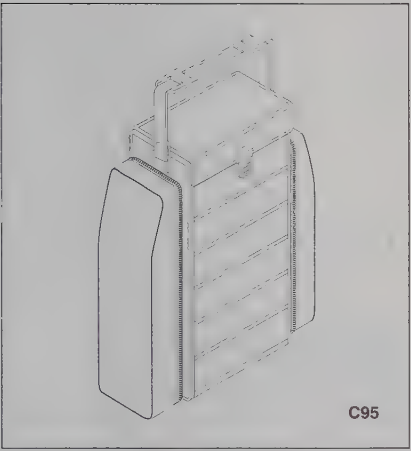


C75

C75 Test Lead Case

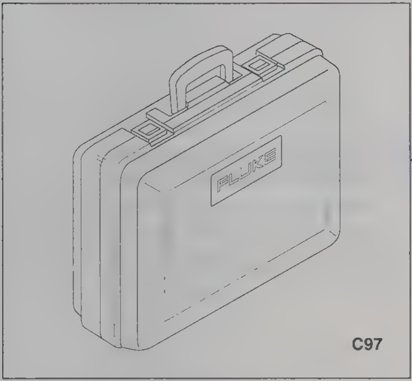
Vinyl protective case with two inside pockets. Designed to carry test leads, or ScopeMeter probes, and clips.

Size: 190 mm x 108 mm x 32 mm (7.25 in x 4.25 in x 1.25 in)



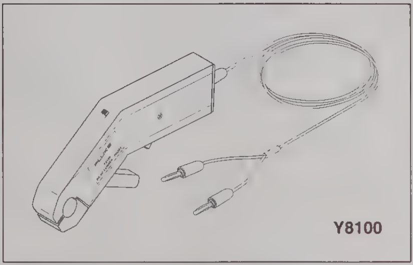
C95 ScopeMeter Soft Case

Soft zippered vinyl carry case for the 90 Series ScopeMeters. Two separate side storage compartments are provided for test leads, probes, power adapter and other accessories. ScopeMeter remains in the case during use, and an integrated tilt stand ensures optimum viewing.



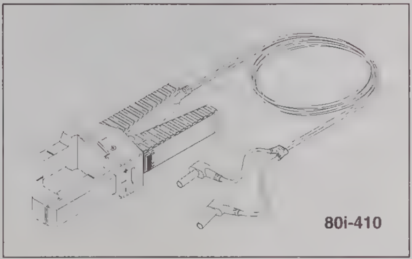
C97 ScopeMeter Hard Case

Heavy duty hard case made of shock resistant polypropylene for the 90 Series ScopeMeters. Contains storage compartments for test leads, probes, manual, power adapter, and other accessories.



Y8100 DC/AC Current Probe

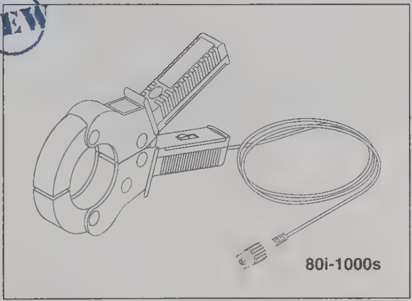
Battery powered Hall-effect dc and ac current probe. Two ranges of 20A and 200A in ac or dc give a 2V output. Full details on page 141.



80i-410 Clamp-on DC/AC Current Probe

A battery powered Hall-effect dc/ac current probe for up to 400A with 1 mV/A sensitivity. Full details on page 141.

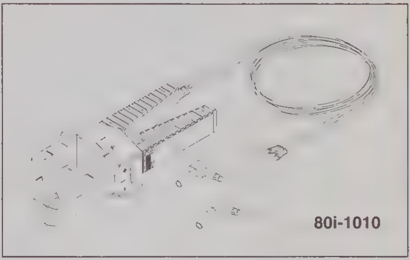
NEW



80i-1000s AC Current Probe

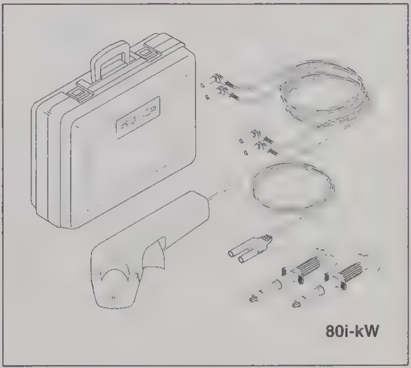
The Model 80i-1000s expands oscilloscope applications in testing commercial and electrical power systems. It allows accurate measurement and display of distorted current waveforms to troubleshoot power quality problems. When used with ScopeMeter it allows simultaneous current and voltage measurements to determine true power and power factor. A 100 kHz low pass filter rejects radio frequency noise. The shrouded safe BNC voltage output allows the probe to measure up to 1000 amps on 600 volt installations, including floating voltages on the ScopeMeter common up to 600 volts.

Current Measurement: 0.1A to 1000A ac rms
Basic accuracy: 2% of reading for 1 and 10 mV/A ranges, 3% ±10 mV for 100 mV/A range, 45 Hz to 1 kHz
Three Switchable Ranges
1 mV per amp (1000A rms, 2000A peak max)
10 mV per amp (100A rms, 200A peak max)
100 mV per amp (10A rms, 20A peak max)
Isolation to Earth: 600V
Usable Frequency Range: 5 Hz to 100 kHz
Maximum Conductor Size: 54 mm (2.1 in)



80i-1010 Clamp-on DC/AC Current Probe

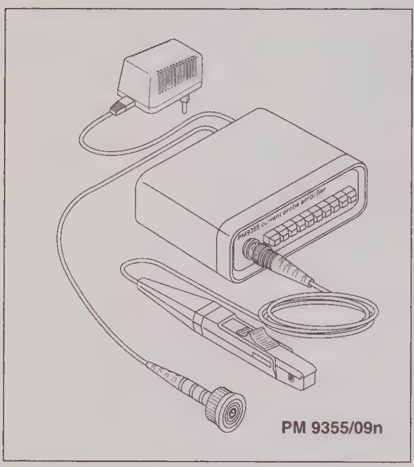
Battery powered dc and ac current probe giving 1 mV/A output for dc current up to 1000A and ac currents up to 700A. Full details on page 141.



80i-kW Current/Power Probe

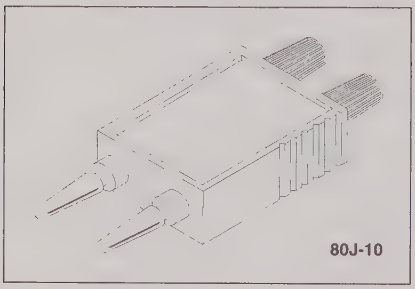
Battery powered probe measures dc current from 1 to 1300 amps, ac current from 1 to 1000 amps and power from 0.5 to 330 kW. Full details on page 141.

Accessories


PM 9355/09n

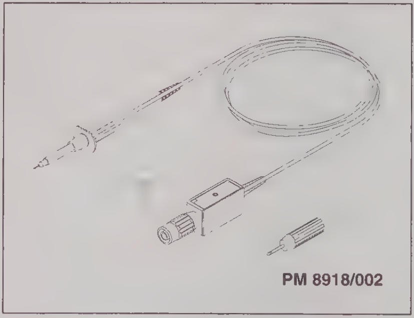
PM 9355/09n AC Current Probe

Line powered high frequency current probe for low current (12A peak-peak max) measurements to 70 MHz. Output ranges 20 mV/mA to 20 mV/A in 10 ranges. Full details on page 44.


80J-10

80J-10 Current Shunt

Low cost current shunt (not fused) giving 10 mV/A output, ac or dc measurements up to 10 amps continuous. Full details on page 144.


PM 8918/002

PM 8918/002/202 ScopeMeter Safety Designed Oscilloscope Probe Sets

Design is optimized for user safety with 90 Series ScopeMeters, these double isolated (according to IEC 1010-1) probes measure a maximum signal voltage 600V, and withstand a maximum surge voltage 6 kV.

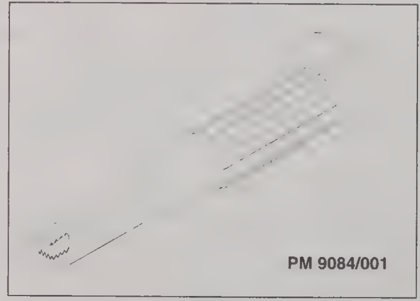
Each set consists of two 10:1 probes, one red and one grey, plus the PM 9094/001 probe accessory set. The length of the PM 8918/002 is 1.5m (5 ft) and 2.5m (8 ft) for the PM 8918/202.

The useful bandwidth of these probes is 100 MHz with an input impedance of 10 MΩ in parallel with 15 pF. The compensation range is from 15 to 35 pF.

NEW

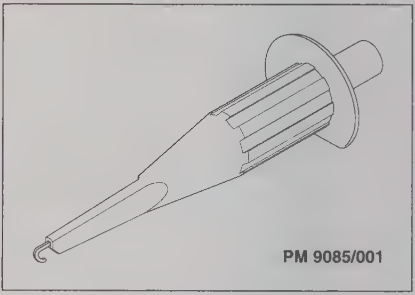
PM 9094/001 Accessory Set for ScopeMeter Probes

Replacement accessory set for the PM 8918 ScopeMeter probes. This set consists of one PM 9081/001 dual banana to female BNC adapter, one red and one grey hook clips with earth lead, two earth leads, one red and one grey high voltage test pins (2 mm), one red and one grey 4 mm adapters (not shrouded), one red and one gray trim screwdrivers.


PM 9084/001

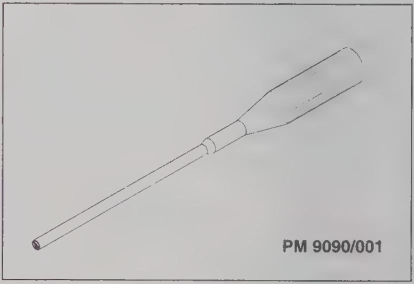
PM 9084/001 ScopeMeter Probe Industrial Alligator Clip

Safety-designed spring-loaded alligator clips with a 19 mm (3/4 in) jaw opening for use with PM 8918 ScopeMeter probes. Maximum voltage of 600V. Set contains one red and one grey clip.


PM 9085/001

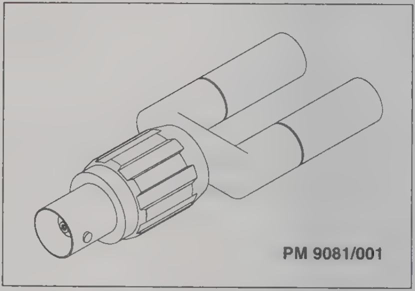
PM 9085/001 ScopeMeter Probe Industrial Hook-Style Clip

Safety-designed spring-loaded hook clip for use with PM 8918 ScopeMeter probes. Hook extends 10 mm (0.40 in) and is 2 mm (0.08 in) deep. Maximum voltage of 600V. Set contains one red and one grey clip.


PM 9090/001

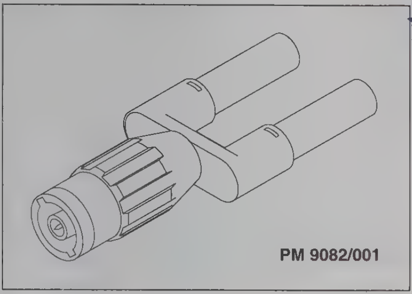
PM 9090/001 ScopeMeter Probe Pin-Grabber Flexible Clip

Safety-designed spring-loaded pin-grabber hooks for use with PM 8918 ScopeMeter probes. Shaft length is 100 mm (4 in) and grabber extends 9.5 mm (3/8 in). Maximum voltage of 600V. Set contains one red and one grey clip.


PM 9081/001

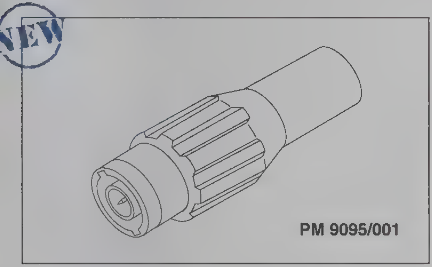
PM 9081/001 Safety-Designed Dual Banana Plug to Female BNC Adapter

Red (signal) and a black (ground) shrouded 4 mm banana plugs connect to a shrouded female BNC connector. Set contains two adapters. Maximum voltage to ground of 600V.


PM 9082/001

PM 9082/001 Safety-Designed Dual Banana Jack to Male BNC Adapter

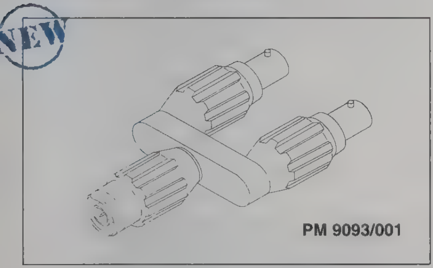
Red (signal) and a black (ground), 4 mm banana jacks connect to a shrouded male BNC connector. Set contains two adapters. Maximum voltage to ground of 600V.



PM 9095/001

PM 9095/001 Safety-Designed Single Banana Jack to Male BNC Adapter

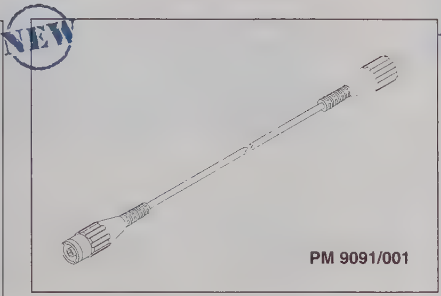
Single banana to BNC adapter for direct connection 4 mm test leads to the BNC inputs of the ScopeMeter. Set consists of one red and one grey adapter. Maximum voltage to ground of 600V. Maximum input signal of 300V.



PM 9093/001

PM 9093/001 Safety-Designed Male BNC to Dual Female BNC Adapter

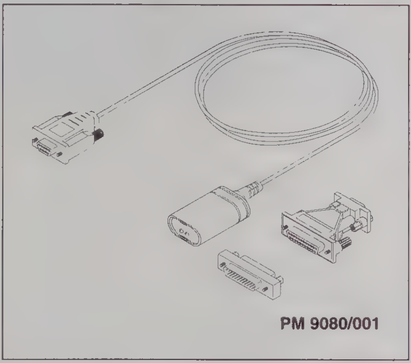
Male BNC to dual female BNC T-piece. Set consists of two adapters. Maximum voltage to ground of 600V. Maximum signal voltage of 300V.



PM 9091/001

PM 9091/001 and PM 9092/001 Safety Designed 50Ω Cable Sets

The PM 9091/001 has cable lengths of 1.5m (5 ft), and the PM 9092/001 0.5m (20"). Each set consists of three black cables with colored BNC male connectors (red, grey and black) for easy identification. Maximum voltage to ground of 600V. Maximum signal voltage of 300V.


PM 9080/001

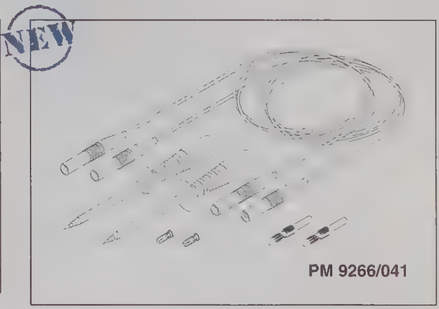
PM 9080/001 RS-232C to ScopeMeter Optical Interface Adapter Cable

Safety-designed serial interface adapter cable for ScopeMeter hard copy output to printer or remote control by a PC. (Model 97 only). This cable connects directly to printers or PCs without an additional power source. Xon/Xoff software handshaking must be supported by the connected peripheral.

Hard Copy Output: ScopeMeter supports Epson FX/LQ and Thinkjet compatible printers.

Remote Control: Scope and Meter measurements can be read, setups, waveforms can be read and programmed, and performance verification and calibration is possible.

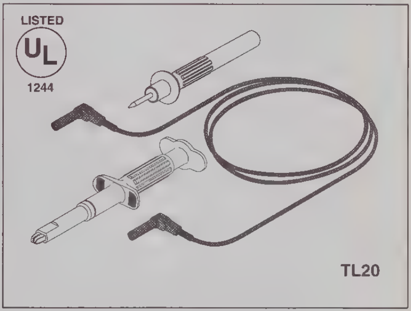
Transmission rates are 1200 and 9600 Baud for the ScopeMeter.



PM 9266/041

PM 9266/041 Sillicone Test Lead Set

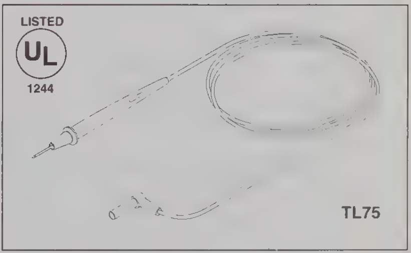
Safety-designed silicone insulated test lead set with a length of 1.5m (5 ft). Set contains two leads, two test probes and two adapters to "non-safety" 4 mm banana plugs, each in red and black. Maximum voltage of 1000V.



TL20

TL20 Industrial Test Lead Set

Set consists of 1.6m (63 in) silicone insulated shrouded test leads (TL22), two test probes (TP20), and two safe alligator clips (AC20). Maximum voltage of 1000V. Full details on page 139.

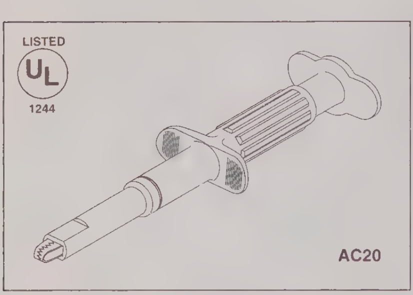


TL75

TL75 Hard Point™ Test Lead Set

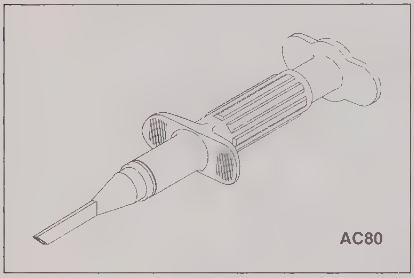
Set consists of two 1.2m (48 in) shrouded PVC test leads with integrated test probes. Full details on page 138.

Accessories



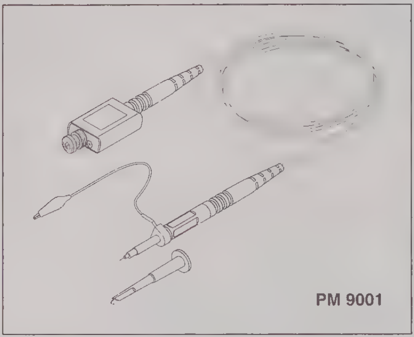
AC20 Industrial Test Clips

Set consists of two safety-designed spring-loaded alligator clips with 19 mm in (3/4 in) jaw opening for use with standard 4 mm banana test leads. Maximum voltage of 1000V. Full details on page 137.



AC80 Hook-Style Test Clips

Set consists of two safety-designed spring-loaded hook clips for use with PM 8918 ScopeMeter probes. Hook extends 10 mm (0.40 in) and is 2 mm(0.08 in) deep. Maximum voltage of 1000V. Full details on page 137.



PM 9001/001 Scope Probe Set 1:1 (5ft, 1.5m)

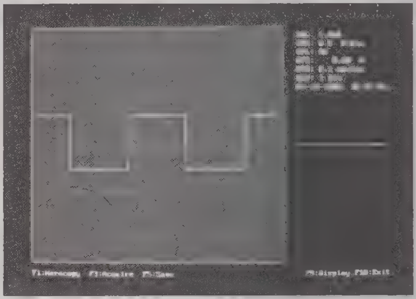
PM 9001/201 Scope Probe Set 1:1 (8 ft, 2.5m)

PM 9011/001 Switchable Scope Probe Set 1:1, 10:1 (5 ft, 1.5m)

Modular 1:1 probes for high sensitivity measurements at lower frequencies. Equipped with command switch and range indicator (/x91 only). Cable length 1.5m (5 ft) (PM 9001/0xx) or 2.5m (8 ft) (PM 9001/2xx).

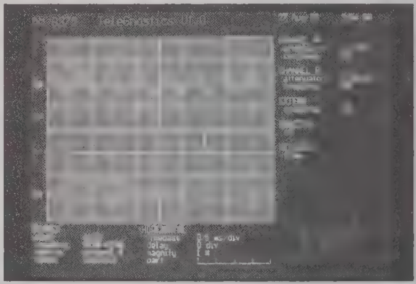
80T-150U Temperature Probe

The 80T-150U is a universal temperature probe designed to provide the ScopeMeter with temperature measuring capability. Full details on page 146.



PM 2270/003 ScopeMeter to PC Communication Software

This enables up and down loading of waveforms and setups between ScopeMeter Model 97 and a PC using the RS-232C interface (PM 9080/001 required). In addition, meter measurements can be read by the PC. All data can be stored in PC files, and exported to most common signal processing packages. Full details on page 47.

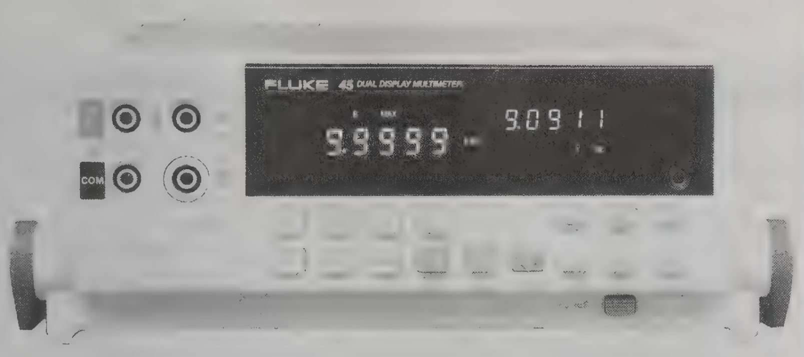


PM 9372/002 Modem Communication Package

This enables communication with a ScopeMeter at a remote site using a modem connection. Up and down loading of waveforms and setups between the remote ScopeMeter Model 97 and the host PC is possible. In addition, meter and scope cursor measurements can be read by the host PC. All data can be stored in PC files, and exported to most common signal processing packages. Full details on page 47.

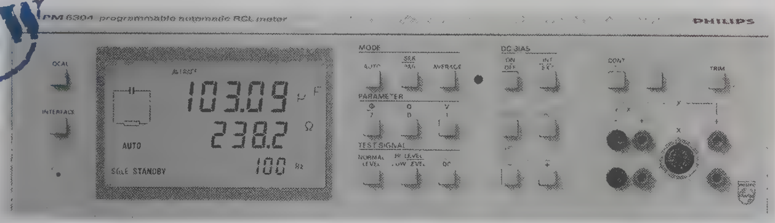
AVAILABLE THROUGH DISTRIBUTORS

System & Bench Multimeters

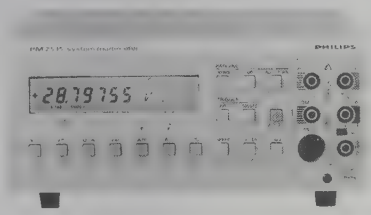

FLUKE 45 DUAL DISPLAY MULTIMETER
9.9999
9.0911
COM

Fluke 45 Page 66

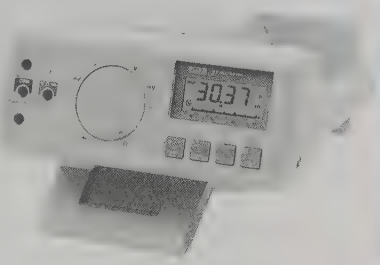
NEW


PM 6304 programmable automatic RCL meter
PHILIPS
103.09
238.2
100
AUTO
SGLE STANDBY

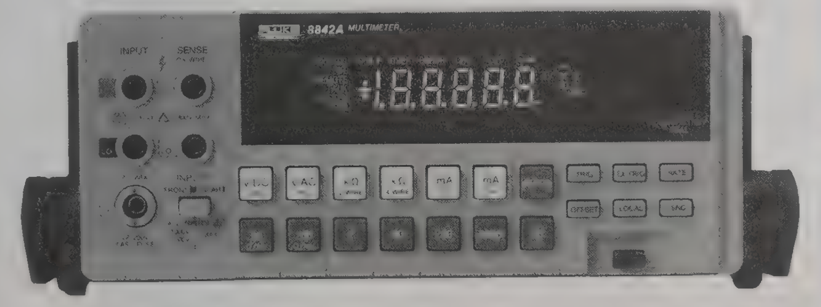
PM 6304 Page 100


PHILIPS
28.79755

PM 2535 Page 63



Fluke 37 Page 88


8842A MULTIMETER
INPUT
SENSE
1.8.8.8.8.8

8842A Page 70

This category of digital multimeters (DMMs) features all the Fluke bench and system meter line. Included are high-speed instruments for use in automated test and measurement systems, and more compact, inexpensive models for less demanding jobs on the workbench or, with battery or battery pack, in the field.

Fluke bench/system multimeters are available with 3½ to 7½ digits of resolution and a variety of accuracy levels. All system meters are available with either GPIB/IEEE-488 or RS-232C interfaces which allow easy system integration.

Testing resistors, capacitors, and inductors has just gotten much easier with the introduction of the new PM 6303A and PM 6304 RCL Meters. These models feature a large LCD display and automatic operation. The PM 6303A (see page 98) is an easy-to-use instrument that is ideal for getting quick component checks. Consider the PM 6304 for enhanced measurement capability and optional RS-232 or GPIB/IEEE-488 remote programmability (see page 100).

See the selection guide on the following page for a comparison of basic specifications and features.

Selection Guide Page 62
System Multimeters Page 63
Bench/System Multimeters Page 66
Bench/Portable Multimeters Page 88
Digital Voltmeters Page 94
Analog Voltmeters Page 97
RCL Meters Page 98

Selection Guide

		DCV			Resistance			ACV					Other Features								
	Digits	Acc. %	Res. μV	Max V	Acc. %	Res. mΩ	Max MΩ	TRMS	Acc. %	Res. μV	Max V	Freq Hz	Speed rds/sec	IEEE -488	RS -232	Offset/ Relative	dB or dBm	Ratio	Burst Mem	Int. Batt.	Page No.
Digital Multimeters																					
8506A	7½	0.0010	0.1	1200	0.003	0.01	265	•	0.016	1	600	1M	500	Δ	Δ	•		•			80
8505A	7½	0.0010	0.1	1200	0.003	0.01	265	Δ	0.100	1	1000	1M	500	Δ	Δ	•		•			80
PM 2534	6½	0.0050	0.1	300	0.020	1	300	•	0.040	10	300	100k	100	•	Δ				•		63
PM 2535	6½	0.0050	0.1	300	0.020	1	300	•	0.040	10	300	100k	100	•	Δ		•		•		63
8842A	5½	0.0025	0.1	1000	0.005	0.10	20	Δ	0.070	1	700	100k	100	Δ		•					70
8840A	5½	0.0040	1	1000	0.010	1	20	Δ	0.140	1	700	100k	100	Δ		•					70
8840A/AF	5½	0.0040	1	1000	0.010	1	20	•	0.140	1	1000	100k	100	Δ		•		•			70
8520A	5½	0.0050	1	1000	0.007	0.10	20	•	0.100	10	650	1M	500	•		•	Δ	•	•		85
8522A	5½	0.0050	1	1000	0.007	0.10	20	•	0.100	10	650	1M	500			•	•	•	•		85
PM 2525	5½	0.0200	1	1000	0.100	10	200	•	0.200	10	750	100k	10	Δ	Δ	•	•			Δ	76
Fluke 45	5	0.0200	1	1000	0.050	1	300	•	0.200	1	750	100k	20	Δ	•	•	•			Δ	66
8050A	4½	0.0300	10	1000	0.050	10	20	•	0.500	10	750	50k	1			•	•			Δ	90
8010A	3½	0.1000	100	1000	0.200	100	20	•	0.500	100	750	50k	1							Δ	92
8012A	3½	0.1000	100	1000	0.200	1	20	•	0.500	100	750	50k	1							Δ	92
Fluke 37	3½	0.1000	100	1000	0.200	100	32		0.500	100	750	30k	2			•				•	88
Wideband True-RMS AC Digital Voltmeters																					
8920A	3½							•	0.500	1	700	20M	2.5	Δ		•	•				94
8921A	3½							•	0.500	1	700	20M	2.5	Δ		•	•				94
8922A	3½							•	0.500	1	700	11M	2.5	Δ		•	•				94
Scanning Multimeters																					
2620A	5	0.0210	10	300	0.05	10	10	•	0.2	10	300	100k	17	Δ	•	•			•	•	194
2625A	5	0.0210	10	300	0.05	10	10	•	0.2	10	300	100k	17		•	•			•	•	194
Analog Multimeters																					
PM 2505		1.5 f.s.d.	1000*	1000	3 f.s.d.	1000*	30		2.5 f.s.d.	1000*	1000	30k								•	97

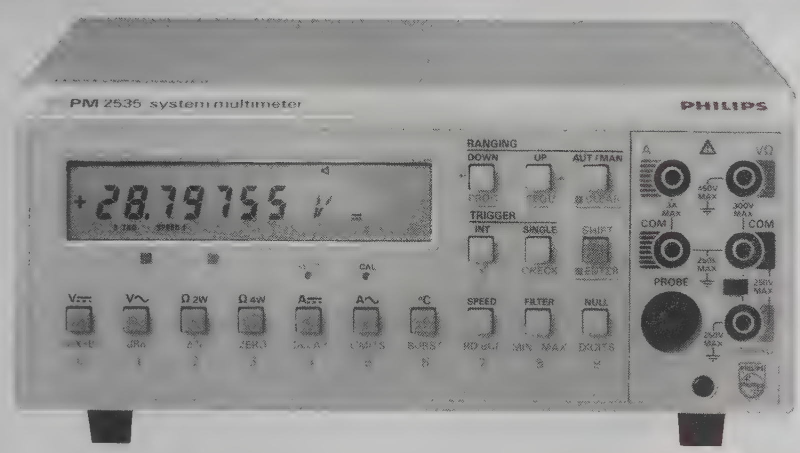
**Sensitivity*
• Standard
Δ Optional

For RCL Meters, see Section 5.
For Handheld Multimeters, see Section 6.
For Multimeter Accessories, see Section 7.

PM 2534 & PM 2535

GPIB
IEEE-488

RS-232



PM 2535

PM 2534 & PM 2535 System Multimeters

- $3\frac{1}{2}$ to $6\frac{1}{2}$ digits
- 100 nV resolution
- 100 measurements/second
- GPIB/IEEE-488 interface standard, RS-232C optional
- Front or rear input
- Scanner extension
- Data calculation, collection and control (PM 2535)

The PM 2534 and PM 2535 Systems Multimeters cover a broad range of applications. While both are suitable for a wide range of general purpose measurements, the PM 2535 offers additional functions for applications demanding data gathering, and fast measurement collecting and processing.

Basic Features

Both the PM 2534 and PM 2535 offer seven measurement functions, front or rear inputs, and $6\frac{1}{2}$ digit guarded sensitive measurements or up to $3\frac{1}{2}$ digit high speed measurements. The units can operate in scan mode under external control via the standard GPIB/IEEE-488* interface.

Extra Capabilities of the PM 2535

As well as the above features, the PM 2535 has built-in data collection, control facilities and calculations including Ax + B, Δ%, dBm and relative measurements. Maximum and minimum values can be stored over a time interval, and warnings can be given if specified limits are exceeded. Burst mode provides up to 150 measurements/sec. Sequence programming allows repetition of the same measurement cycle.

Fast Measurement and Output

At a touch of the 'speed' button, the PM 2534 and PM 2535 step through $6\frac{1}{2}$, $5\frac{1}{2}$, $4\frac{1}{2}$, and $3\frac{1}{2}$ digit modes, enabling the optimum speed/resolution combination to be selected for every application. At a $3\frac{1}{2}$ digit resolution the instrument makes 100 measurements per second and can transmit the measured values through its standard GPIB interface at the same rate.

V DC Measurement Speed (Incl Controller)

Digits	Trigger Mode	Measurements/s
$3\frac{1}{2}$	Internal	100
$3\frac{1}{2}$	IEEE-488	50
$4\frac{1}{2}$	IEEE-488	30
$5\frac{1}{2}$	IEEE-488	3
$6\frac{1}{2}$	IEEE-488	0.3

Typical measurement speeds

Measurement Capabilities

The performance of these instruments cover more than dc voltages alone. In fact, seven measuring functions, including temperature are standard.

Function	Maximum Resolution	Maximum Range	Accuracy (90-Day)
V dc	100 nV	300V	0.005%
V ac	10 μV	300V	0.2%
I dc	100 nA	3A	0.03%
I ac	10 μA	3A	0.2%
Ω 2-wire	1 mΩ	300 MΩ	0.02%
Ω 4-wire	1 mΩ	3 MΩ	0.02%
°C via Pt-100	0.1°C	-100°C to +850°C	0.3%

Operator and Application Friendly

Single button selection of function, range and trigger modes make the PM 2534 and PM 2535 very simple to use. Precise measurements are always made very quickly thanks to the 'NULL' key to compensate for small offsets and the 'FILTER' key to eliminate small instabilities on dc signals.

Access to the GPIB address and mode of operation is under the 'CHECK' function but to prevent unauthorized use in systems application this can be 'locked-out' resulting in a 100% tamper free front panel.

And emphasizing the system-oriented design even further, the standard facility for full electronic calibration allows simple recalibration either via the GPIB bus, or manually, without the need to open the case.

Data Collection

The PM 2535 also has a 999-point buffer which is constantly active. This ensures that the last 999 measurements can be reviewed at any time.

The PM 2535 can measure at up to 150 measurements/sec, and by storing these directly in the internal buffer, more than 6 seconds of high-speed measurements can be collected regardless of the controller's speed.

Controlling System 21 Modules

With the PM 2534 and PM 2535, System 21 can be added to any GPIB application to provide a modular and cost-effective solution to system switching. Both the PM 2534 and the PM 2535 have a System 21 master unit built-in, enabling them to control the PM 2120 universal switches or the PM 2121 low level switches.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 2534 & PM 2535

Specifications

Technical Specifications

DC Volts/DC Amps

Ranges	Maximum Resolution	Accuracy: 5½ or 6½ Digits in % Rdg + % Range 24 Hrs (tcal ±1°C)	90 Days (tcal ±5°C)	1 Year (tcal ±5°C)
300 mV	100 nV	0.0025 + 0.0013*	0.007 + 0.0017*	0.012 + 0.0017*
3V	1 µV	0.0020 + 0.0010	0.005 + 0.0013	0.010 + 0.0013
30V	10 µV	0.0025 + 0.0013	0.006 + 0.0017	0.015 + 0.0017
300V	100 µV	0.0025 + 0.0010	0.006 + 0.0013	0.010 + 0.0013
30 mA	100 nA	0.01 + 0.005	0.03 + 0.005	0.05 + 0.005
3A (<1A)	10 µA	0.01 + 0.005	0.03 + 0.005	0.05 + 0.005
3A (>1A)	10 µA	0.10 + 0.0	0.15 + 0.01	0.20 + 0.01

**Valid when using "NULL"*

Operation Modes Scale Length	Speed Measurements/Sec	Normal Mode Rejection 50-60 Hz ±0.1%	50-60 Hz ±1.0%	Common Mode Rejection* DC	50-60 Hz ±0.1%	50-60 Hz ±1%
3000000	0.3	>80 dB	>60 dB	>140 dB	>160 dB	>140 dB
300000	3.0	>70 dB	>50 dB	>140 dB	>150 dB	>130 dB
30000	30	>60 dB	>40 dB	>140 dB	>140 dB	>120 dB
3000	100 (150)**	—	—	>140 dB	>80 dB	>80 dB

**Measured with 1 kΩ unbalance and guard connected to CM voltage* ***For PM 2535 using internal buffer*

Temperature Coefficient
Input Impedance: DC volts, 10 MΩ
DC Volts: ±(0.002% reading + 0.0005% range)
DC Amps: ±(0.005% reading + 0.001% range)
Maximum Input Voltage: 600V peak, 300V continuous
Maximum NM Voltage: 140% of selected range
Maximum CM Voltage: 350V peak, lo to guard; 350V peak, guard to ground
Filters: User selectable digital
Clip Indication: † is displayed when input circuitry clips during measuring cycle
Null Range: ±100 µV
Protection: 3.15A fuse

AC Volts (RMS)/AC Amps

Ranges	Maximum Resolution	Input Characteristics	Accuracy: 4½ or 3½ Digits in %Reading + %Range Valid from 1% to 100% of Range Frequency Range	24 Hrs (tcal ±5°C)	90 Days (tcal ±5°C)	1 Year (tcal ±5°C)
300 mV 3V	10 µV 100 µV	1.2 MΩ//30 pF	40/400 Hz - 5 kHz	0.10 + 0.10	0.20 + 0.10	0.30 + 0.10
30V 300V	1 mV 10 mV	0.93 MΩ//30 pF	5 kHz-100 kHz (per kHz)	0.02 + 0.02	0.04 + 0.02	0.06 + 0.02
30 mA	1 µA	<250 mV drop	*40/400 Hz - 1 kHz	0.1 + 0.1	0.2 + 0.10	0.3 + 0.1
3A	100 µA	<600 mV drop	*40/400 Hz - 1 kHz	0.1 + 0.1	0.2 + 0.10	0.3 + 0.1

**Analog Filter on/off*

Operation Modes Scale Length	Speed Measurements/Sec
30000	2.5
3000	25

Protection: 3.15A fuse
Crest Factor: 3.3 at full scale, increasing down scale. Crest factor overload indicated by 1 on display.
Temperature Coefficient: <0.03%/°C
Maximum Volt-Hertz Product: 10^7

CMRR: With 1 kΩ unbalance and guard to '0': >120 dB for dc signals; >80 dB for 50/60 Hz ac signals
Maximum Input Voltage: 600V peak, 400V continuous
Input Impedance
300 mV & 3V: 1.2 MΩ//30 pF
30V & 300V: 0.93 MΩ//30 pF

Ohms (2-Wire and 4-Wire)

Ranges	Maximum Resolution	Accuracy $6^1/_2$ or $5^1/_2$ Digits in % Reading + % Range			Input Characteristics (Non-Linear)
		24 Hours (tcal ±1°C)	90 Days (tcal ±5°C)	1 Year (tcal ±5°C)	
3 kΩ	1 mΩ	0.010 + 0.0033	0.02 + 0.0033	0.03 + 0.0033	1 mA drive
30 kΩ	10 mΩ				100 µA drive
300 kΩ	100 mΩ				10 µA drive
3 MΩ	1Ω	0.020 + 0.0033	0.04 + 0.0033	0.05 + 0.0033	1 µA drive
30 MΩ*	100Ω	0.060 + 0.0033	0.10 + 0.0033	0.15 + 0.0033	100 nA drive
300 MΩ*	10 kΩ	0.8 + 0.033	1.6 + 0.033	2.0 + 0.033	10 nA drive

Only in 2-wire configuration

Operation Modes Scale Length	Speed Measurements/Sec
3000000	0.25
300000	2.5
30000	25
3000*	65

Excluding 3 MΩ, 30 MΩ and 300 MΩ ranges

Maximum Open Circuit Voltage: 10V
Maximum 4-Wire Lead Resistance: 100Ω
Protection 2-Wire Terminals: 250V ac or dc, 350V peak
Protection 4-Wire Terminals: 30V ac or dc, 42V peak
Maximum CM Voltage: 2-wire: 250V ac or dc, 350V peak between '0' and guard, or between guard and ground; 4-wire: 30V ac or dc, 42V peak between '0' and ground; guard must be connected to '0'
Linearization: According to DIN 43760
Max Voltage: Between '0' and guard 30V ac or dc, 42V peak

General Specifications

Power Requirements

Power Supply: 115V or 230V (±10%)
Line Frequency: 50 Hz or 60 Hz (±1%)
Power Consumption: 20 VA
Safety Class: IEC 348 Class I
MTBF: 32,000 hours
Calibration Interval: 1 year

Environmental Data

Reference Temperature: 23°C ±1°C
Rated Range of Use: 0 to +50°C
Operating Range: 0 to +55°C
Storage and Transport: -25°C to +70°C
Limits of Humidity for Operation: 20 to 80%
Max Dew Point: +25°C

Mechanical Data

Size: 280 W mm x 210 L mm x 86 H mm (11 W in x 8.3 L in x 3.4 H in.)
Weight: 2.9 kg (6.2 lb)

Temperature (via Pt 100 RTD probe)*

Meter Ranges	Resolution	Accuracy	Measurements/Sec
-100°C to 850°C	1.0°	0.3% reading + 0.2°C	30
-100°C to +850°C	0.1°C	0.3% reading + 0.2°C	3

For optional accuracy see PM 9249/01 RTD Probe

Ordering Information

Models

PM 2534/02n System Multimeter
PM 2535/02n System Multimeter

The n' indicates the required line cord. To select your line cord substitute the n' by:

1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

Included with Instrument

One-year product warranty, set of safety test leads with probes, spare fuses, operator and service manuals.

Accessories (Also see Section 7)

HM 9606/00 Rack Kit for PM 2534/5 and PM 6660 Family of counters
PM 2193/03 Rack Kit for PM 2534/5 and up to 4 system 21 modules (3E height)
PM 9071 Coax Cable, 135Ω, Banana
PM 9072 Coax Cable, 135Ω, BNC - Banana
PM 9190/02 RS-232C Interface
PM 9193/02 Analog Output Option
PM 9210 High Frequency 150 mV Probe, 10 kHz to 1 GHz
83RF High Frequency Probe, 100 kHz to 100 MHz
PM 9244 AC and DC Current Shunt up to 31.6A
PM 9245 AC Current Transformer 10A to 150A
PM 9246/03 High Tension Probe
PM 9249/01 Temperature Probe
PM 9264/01 4-wire Test Lead for resistor measurement
PM 9265/01 Shielded 3-wire Test Lead
PM 9266/03 Set of Test Leads with Probes
PM 9267/01 Data Hold Probe
PM 9280/04 19" Rack Mount Adapter (2E height)

Manuals

PM 2534 Operator*
PM 2534 Programming Card
PM 2535 IEEE Programming Card
PM 2535 Operator*
PM 2535 Programming Guide

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty

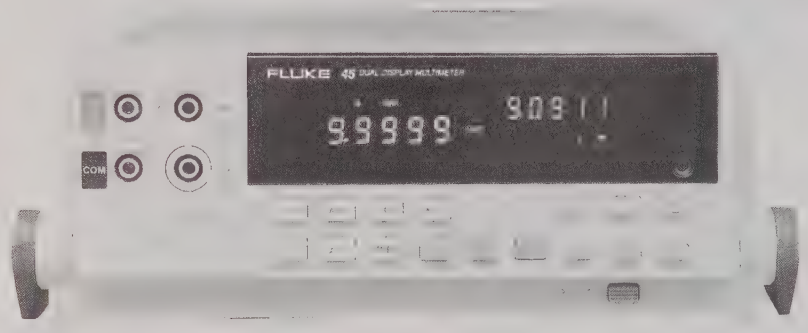
One-year product warranty.

45

GPIB
IEEE-488

Available through Distributors

RS-232



D V E

Fluke 45

45 Dual Display Multimeter

- Multifunction vacuum fluorescent dual display
- True-rms voltage and current, including ac + dc
- RS-232C interface standard, GPIB/IEEE-488.2 optional
- Frequency measurement to 1 MHz
- dB measurements with selectable reference impedances of 2Ω to 8000Ω and audio power from 2Ω to 16Ω
- Compare (Hi/Lo/Pass) function for quick in-tolerance tests
- 0.05% dc current accuracy for 4-20 mA current loop service
- Touch Hold,® Relative and Min Max
- Audible continuity and diode test
- Optional rechargeable battery, carrying case, rack mount kit & PC software package
- Closed-case calibration

The Fluke 45 is a feature-rich 5 digit, 100,000 count DMM with a unique multifunction dual display, allowing measurement of two signal parameters from a single test connection. The Fluke 45 offers high performance and versatility for manufacturing test, depot and field service, and research and development. A standard RS-232C makes it ideal for PC instrument applications.

Dual Display

The Fluke 45 is the first DMM with a multifunction "dual display," allowing the user to select a wide variety of measurement combinations. It is particularly useful in applications requiring two different measurements of the same signal; i.e. power supply testing, where V dc output can be viewed on the primary display while the V ac ripple is shown on the secondary display.

Standard RS-232C Interface

The RS-232C interface, standard in each instrument, allows measurement data to be filed, manipulated, printed or transmitted by modem. The print mode automatically formats measurement data for printing on an RS-232C printer. Rates for automated printing over RS-232C are adjustable from 1 reading every 70 ms to 1 reading every 5.6 hours. The optional QuickStart 45™ Software Package allows automated communications and filing of measurements with the Fluke 45 and an IBM-PC or compatible via RS-232C.

dB Measurement

The Fluke 45 provides digital readout of decibels with front panel selection of any of twenty-one reference impedances from 2Ω to 8000Ω. For 2Ω, 4Ω, 8Ω and 16Ω impedances, the meter automatically calculates and displays audio power in watts.

Compare Function

The Fluke 45 has a compare function for fast in-tolerance limits testing. Upper- and lower-limits are entered through the front panel. Readouts show both a Hi/Lo/Pass evaluation and measured value.

Touch Hold Relative and Min/Max

Touch Hold captures the measurement, beeps and locks it on the digital display until you are ready to view it. It automatically updates with each new stable measurement. The Relative mode remembers a reading and shows the change (difference) between it and any readings that follow. Min/Max records the highest and lowest values measured. Either can be recalled and displayed at any time.

Optional Battery and Case

An optional rechargeable battery and soft carrying case are available for precision field service applications. These options, coupled with a 30 mA dc current range and 0.05% accuracy, allow calibration of 4-20 mA loops in process control applications. The battery is available as a factory installed option or can be user-installed at a later date.

Optional GPIB/IEEE-488.2 and Rack Mount

The Fluke 45 may be used with GPIB/IEEE-488.2* systems, including existing IEEE-488 implementations. The IEEE-488.2 option is available as a factory installed option, or can be user installed and does not require removal of the RS-232C interface. A rack mount kit is also available.

Closed-Case Calibration

Calibration can be performed via the RS-232C (or optional IEEE-488.2) interface or manually from the front panel. No internal adjustments are required.

Standard Equipment

Each Fluke 45 Dual Display Multimeter includes an operator's manual, quick reference guide, line cord, and test leads.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Specifications

Technical Specifications

Accuracy specifications are given as ± ([% of reading] + [number of least significant digits]) at 18°C to 28°C with relative humidity up to 90%, for a period of one year after calibration. Six months specifications are also provided for dc volts. AC inputs are ac-coupled and true-rms responding.

Display

Dual vacuum fluorescent displays, 99,999 counts each display. Annunciators: m, M, k, V, A, Ω (ohms), Hz, → + diode test,))))) (audible continuity), REMOTE, EXT TRIG, SMF (reading rates), MAX, MIN, dB, HOLD, REL, AUTO, [− +] (low battery). Resolution and accuracy are dependent on selectable reading rates of 2.5 (slow), 5 (medium) or 20 (fast) readings per second.

Rate	Readings Per Second	Full Range Display Counts
Slow	2.5	99,999
Medium	5	30,000
Fast	20	3000

RS-232C and IEEE-488 Reading Transfer Rates

Internal Trigger Operation (TRIGGER 1)	
Rate	**Readings Per Second**
Slow	2.5
Medium	4.5
Fast	4.5
External Trigger Operation (TRIGGER 4)	
Rate	**Readings Per Second**
Slow	1.5
Medium	2.4
Fast	3.8
Print Mode Operation (Print set at 1)	
Rate	**Readings Per Second**
Slow	2.5
Medium	5.0
Fast	13.5

DC Voltage

Range	Resolution			Accuracy (6 Month)	Accuracy (1 Year)
	Slow	Medium	Fast		
300 mV	—	10 µV	100 µV	0.02% + 2	0.025% + 2
3V	—	100 µV	1 mV		
30V	—	1 mV	10 mV		
300V	—	10 mV	100 mV		
1000V	—	100 mV	1V		
100 mV	1 µV	—	—	0.02% + 6	0.025% + 6
1000 mV	10 µV	—	—		
10V	100 µV	—	—		
100V	1 mV	—	—		
1000V	10 mV	—	—		

Input Impedance: 10 MΩ in parallel with <100 pF
Normal Mode Rejection Ratio: >80 dB at 50 or 60 Hz, slow and medium rates; >54 dB for frequencies between 50 and 440 Hz, slow and medium rates; >60 dB at 50 Hz, fast rate
Common Mode Rejection Ratio: >90 dB at dc, 50 or 60 Hz (1 kΩ unbalanced, slow & medium rates)
Maximum Input: 1000V dc or peak ac on any range

AC Voltage (true-rms, ac coupled)

Range	Linear Resolution			Range	Linear Resolution		
	Slow	Medium	Fast		Slow	Medium	Fast
300 mV	—	10 µV	100 µV	100 mV	1 µV	—	—
3V	—	100 µV	1 mV	1000 mV	10 µV	—	—
30V	—	1 mV	10 mV	10V	100 µV	—	—
300V	—	10 mV	100 mV	100V	1 mV	—	—
750V	—	100 mV	1V	750V	10 mV	—	—

Decibels Resolution	
Slow/Medium	**Fast**
0.01 dB	0.1 dB

Frequency	Linear Accuracy			dB Accuracy		Power*	Max Input Upper Freq
	Slow	Medium	Fast	Slow/Med	Fast		
20-50 Hz	1%+100	1%+10	7%+2	0.15	0.72	2%+10	750V
50 Hz-10 kHz	0.2%+100	0.2%+10	0.5%+2	0.08	0.17	0.4%+10	750V
10-20 kHz	0.5%+100	0.5%+10	0.5%+2	0.11	0.17	1%+10	750V
20-50 kHz	2%+200	2%+20	2%+3	0.29	0.34	4%+20	400V
50-100 kHz	5%+500	5%+50	5%+6	0.70	0.78	10%+50	200V

**Error in power mode will not exceed twice the linear accuracy specification*

Accuracy specifications apply within the following limits, based on reading rate:
Slow: Between 15,000 counts and full range
Medium: Between 1500 counts and full range
Fast: Between 150 counts and full range
Input Impedance: 1 MΩ in parallel with <100 pF
Maximum Crest Factor: 3.0
Common Mode Rejection Ratio: >60 dB at 50 or 60 Hz (1 kΩ unbalanced medium rate)
Maximum Input: 750V rms, 1000V peak
2×10^7 volt-hertz product on any range, normal mode input
1×10^6 volt-hertz product on any range, common mode input

AC + DC Voltage (calculated)

Total measurement error will not exceed the sum of the separate ac and dc accuracy specifications, plus one display count.

45

Ohms

Range	Resolution			Accuracy	Typical Full Scale Voltage	Max Current Thru Unknown
	Slow	Medium	Fast			
300Ω	—	10 mΩ	100 mΩ	0.05% + 2 + 0.02Ω	0.25	1 mA
3 kΩ	—	100 mΩ	1Ω	0.05% + 2	0.24	120 µA
30 kΩ	—	1Ω	10Ω	0.05% + 2	0.29	14 µA
300 kΩ	—	10Ω	100Ω	0.05% + 2	0.29	1.5 µA
3 MΩ	—	100Ω	1 kΩ	0.06% + 2	0.30	150 nA
30 MΩ	—	1 kΩ	10 kΩ	0.25% + 3	2.25	320 nA
300 MΩ	—	100 kΩ	1 MΩ	2%	2.90	320 nA
100Ω	1 mΩ	—	—	0.05% + 8 + 0.02Ω	0.09	1 mA
1000Ω	10 mΩ	—	—	0.05% + 8 + 0.02Ω	0.10	120 µA
10 kΩ	100 mΩ	—	—	0.05% + 8	0.11	14 µA
100 kΩ	1Ω	—	—	0.05% + 8	0.11	1.5 µA
1000 kΩ	10Ω	—	—	0.06% + 8	0.12	150 nA
10 MΩ	100Ω	—	—	0.25% + 6	1.50	150 nA
100 MΩ	100 kΩ	—	—	2% + 2	2.75	320 nA

Open Circuit Voltage: 3.2V max on 100Ω, 300Ω, 30 MΩ, 100 MΩ & 300 MΩ ranges; 1.5V max on all other ranges
Input Protection: 500V dc or ac rms on all ranges

DC Current

Range	Resolution			Accuracy	Typical Full Scale Burden Voltage
	Slow	Medium	Fast		
30 mA	—	1 µA	10 µA	0.05% + 3	0.45V
100 mA	—	10 µA	100 µA	0.05% + 2	1.4V
10A	—	1 mA	10 mA	0.2% + 5	0.25V
10 mA	100 nA	—	—	0.05% + 20	0.14V
100 mA	1 µA	—	—	0.05% + 5	1.4V
10A	100 µA	—	—	0.2% + 7	0.25V

Maximum Input: To be used in protected, low-energy circuits only, not to exceed 250V or 4800 volt-amps
mA: 300 mA dc or ac rms. Protected with a 500 mA, 250V, IEC 127 sheet 1 fast blow fuse
A: 10A dc or ac rms continuous or 20A dc or ac rms for 30 seconds maximum. Protected with a 15A, 250V, 10,000A interrupt rating fast blow fuse.

AC Current (true-rms, ac coupled)

Range	Resolution			Typical Full Scale Burden Voltage
	Slow	Medium	Fast	
10 mA	100 nA	—	—	0.14V
30 mA	—	1 µA	10 µA	0.45V
100 mA	1 µA	10 µA	100 µA	1.4V
10A	100 µA	1 mA	10 mA	0.25V

Range	Frequency	Accuracy		
		Slow	Medium	Fast
mA	20-50 Hz	2% + 100	2% + 10	7% + 2
mA	50 Hz-10 kHz	0.5% + 100	0.5% + 10	0.8% + 2
mA	10-20 kHz	2% + 200	2% + 20	2% + 3
A (1A to 10A)	20-50 Hz	2% + 100	2% + 10	7% + 2
A (1A to 10A)	50 Hz-2 kHz	1% + 100	1% + 10	1.3% + 2
A (0.5A to 1A)	20-50 Hz	2% + 300	2% + 30	7% + 4
A (0.5A to 1A)	50 Hz-2 kHz	1% + 300	1% + 30	1.3% + 4

Accuracy specifications apply within the following limits, based on reading rate:
Slow: Between 15,000 counts and full range; **Medium:** Between 1500 counts and full range; **Fast:** Between 150 counts and full range

Maximum Input: To be used in protected, low-energy circuits only, not to exceed 250V or 4800 volt-amps
mA: 300 mA dc or ac rms. Protected with a 500 mA, 250V, IEC 127 sheet 1 fast blow fuse
A: 10A dc or ac rms continuous or 20A dc or ac rms for 30 seconds maximum. Protected with a 15A, 250V, 10,000A interrupt rating fast blow fuse.
Maximum Crest Factor: 3.0

AC + DC Current (calculated)

Total measurement error will not exceed the sum of the separate ac and dc accuracy specifications, plus one display count

Diode Test/Continuity

Accuracy	Maximum Reading	Resolution
Slow	999,99 mV	10 µV
Medium	2.5V	100 µV
Fast	2.5V	1 mV

Test Current: Approximately 0.7 mA when measuring forward bias junction
Audible Tone: Continuous tone for continuity. Brief tone for normal forward biased diode or semiconductor junction
Open Circuit Voltage: 3.2V maximum
Continuity Capture Time: 50 µs maximum, 10 µs typical
Input Protection: 500V dc or ac rms

Frequency

Frequency Range: 5 Hz to >1 MHz
Accuracy: 0.05% + 1, except 1000 Hz range, 0.05% + 2

Range	Resolution	
	Slow/Medium	Fast
1000 Hz	10 MHz	100 MHz
10 kHz	100 MHz	1 Hz
100 kHz	1 Hz	10 Hz
1000 kHz	10 Hz	100 Hz
1 MHz*	100 Hz	1 kHz

** Specified to 1 MHz, usable to 8 MHz when overdriven*

Sensitivity of AC Voltage	
Frequency	Level
5 Hz-100 kHz	30 mV rms sinewave
100 kHz-300 kHz	100 mV rms sinewave
300 kHz-1 MHz	1V rms sinewave
Above 1 MHz	Not specified

Sensitivity Level of AC Current		
Frequency	Input	Level
5 Hz-20 kHz	100 mA	+ 3 mA rms sinewave
45 Hz-2 kHz	10A	+ 3A rms sinewave

Environmental

Warmup Time: 1 hour to rated specifications
Temperature Coefficient: <0.1 times the applicable accuracy specifications per degree C from 0°C to 18°C and from 28°C to 50°C, (32°F to 64.4°F and 82.4°F to 122°F)
Operating Temperature: 0°C to 50°C (32°F to 122°F)
Storage Temperature: -40°C to 70°C (-40°F to 158°F). Elevated temperature storage of battery will accelerate battery self-discharge. Maximum storage time before battery must be recharged:

20°C to 25°C	1000 days
50°C	180 days
70°C	40 days

Relative Humidity (non-condensing): Up to 90%, 0°C to 28°C (32°F to 82.4°F); up to 80%, 28°C to 35°C (82.4 °F to 95°F); up to 70%, 35°C to 50°C (95°F to 122°F), except 70%, 0°C to 50°C (32°F to 122°F) for the 1 MΩ, 3 MΩ, 10 MΩ, 30 MΩ, 100 MΩ and 300 MΩ ranges.
Altitude: Operating, 0 to 10,000 feet; non-operating, 0 to 40,000 feet
Vibration: 3G @ 55 Hz per MIL-T-28800D, Class 3, Style E
Shock: Half-sine 40G per MIL-T-28800D, Class 5, Style E. Bench handling. Shipping container.

General Specifications

Maximum Common Mode Voltage: 1000V dc or peak ac from any earth input
Power: 90 to 264V ac (no switching required), 50 and 60 Hz <15 VA minimum
Safety: IEC 664 Installation Category II, Pollution Degree 2, complies with IEC 348, UL1244, EMI/RFI, CSA bulletin 556B and ANSI/ISA-582.01-1988
RS-232: Baud rates: 300, 600, 1200, 2400, 4800, and 9600. Odd, even or no parity. One stop bit, eight data bits.
External Trigger Input: VIH 1.35V minimum. VIL 1.25V maximum. Input threshold hysteresis, 0.6V maximum.
Size: 9.3 cm H x 21.6 cm W x 28.6 cm D (3.67 in H x 8.5 in W x 11.27 in D)
Weight: 2.35 kg (5.2 lb) net, 4.0 kg (8.7 lb) shipping; with battery 3.2 kg (7.0 lb) net, 4.8 kg (10.5 lb) shipping

Options

IEEE-488.2: Capability codes SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, E1, TE0, LE0 and C0
Battery: Type – lead acid. Operating time – 8 hours typical, annunciator warns when less than $^1/_2$ hour of battery operation remains. Recharge time – 16 hours typical, instrument off; trickle charge maintains charge on battery with instrument on. Operating and storage temperature same as for instrument.

PC Software for the Fluke 45

The QuickStart 45 Software Package helps you take advantage of the Fluke 45's standard RS-232C interface and your PC's resident RS-232C interface to harness the full computing power of your PC to the measurement capablities of the Fluke 45.

QuickStart 45 lets even a non-programmer quickly get on-line and communicate with the Fluke 45 over RS-232C. With QuickStart 45, you can set up tests to run on an IBM PC® or compatible, take readings from the Fluke 45, and file them in. PRN format allowing access from Lotus 1-2-3® and other popular personal computer applications programs.

Easy Tests Controlled by Your PC

QuickStart 45 aids you in the creation of your own test procedures for the Fluke 45. You select the test parameters and QuickStart 45 generates the command syntax, making test generation easy for even non-programmers. Those procedures may then be saved and run with the touch of a single function key, enabling the easy call-up of test procedures.

A simplified editor which allows you to write and modify programs is also provided by QuickStart 45. The editor allows you to insert, delete or modify Fluke 45 remote commands, QuickStart 45 commands, programmer comments, operator messages and branching labels.

The QuickStart 45 editor allows you to create programs which call up other programs, branch to labeled program statements, loop, customize the startup sequence and much more. Programs written or edited by any text editor that saves files in ASCII can be run with QuickStart 45.

The following trademarks are registered and acknowledged:
IBM PC: International Business Machines Corporation
Lotus 1-2-3: Lotus Development Corporation

Ordering Information

Models

Fluke 45 Dual Display Multimeter
Fluke 45-01* w/Battery
Fluke 45-05* w/IEEE-488.2
Fluke 45-15* w/Battery & IEEE-488.2

** Factory installed*

Included with Instrument
One-year product warranty, line cord, TL70A test leads, Quick Reference Guide and Operator manual.

Included with Software
QuickStart 45 User's manual, Fluke 45 Quick Reference Guide, one $5^1/_4$" double-sided double density diskette (360K byte), one $3^1/_2$" double-sided diskette (770K byte), slip case and binder for both the QuickStart 45 and the Fluke 45 User's manual.

Options
-01K Rechargeable Battery Kit*
-05K IEEE-488.2 Interface Kit*

**Field/customer installable*

Accessories (Also see Section 7)
C40 Soft Carrying Case
M00-200-634 $3^1/_2$ Rack Mount Kit
RS40 RS-232C Terminal Cable (6') (DB-9 to DB-25 female connector, connects to PC, PC/XT or PS/2)*
RS41 RS-232C Modem Cable (6') (DB-9 to DB-25 male connector)
RS42 RS-232C to Printer Cable (for 262XA-801 & serial printers)
S45 QuickStart 45

**For PC/AT, join both RS40 and RS41*

Manuals
Fluke 45 Operator*
Fluke 45 Service
Fluke 45 Quick Reference*
Fluke 45 QuickStart*

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

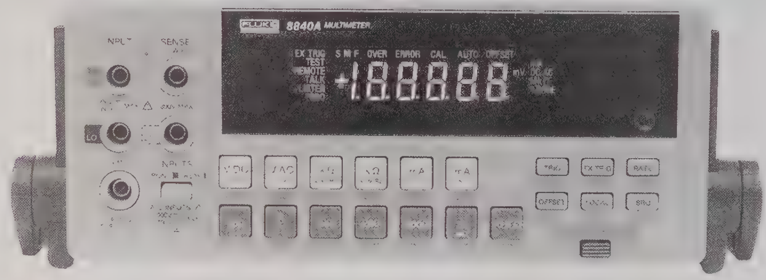
Factory Warranty
One-year product warranty.

AVAILABLE THROUGH DISTRIBUTORS

8840 Series

GPIB IEEE-488

Available through Distributors



(NSN 6625-01-217-9427) **8840A**

8840A 5½ Digit Multimeter

- 0.005% basic 1 year dc accuracy
- Ohms and dc current standard – ac voltage and current optional
- Full system capability with optional GPIB/IEEE-488 interface
- Up to 100 readings/second system speed
- Easy-to-use front panel
- Vacuum fluorescent display
- Closed-case calibration – comprehensive self-test
- NSN 6625-01-217-9427

8840A/AF 5½ Digit Multimeter – The 8840A features plus

- AC voltage and current standard – maximum ac input 1000V rms
- DC/DC voltage ratio
- Enhanced environmental envelope and EMI/RFI protection
- Compliance with MIL-T-28800C Type 11, Class 3, Style B
- NSN 6625-01-196-0014

8842A 5½ Digit Multimeter – The 8840A with higher accuracy and sensitivity

- 0.003% basic 1 year dc accuracy
- Increased resolution with 20 mV, 200 mA, and 20Ω ranges
- Extended calibration cycle with 2 year specifications
- Two-year warranty

Performance

The 8840 Series has performance you would expect in multimeters costing much more. Basic dc accuracies to 0.003% and basic ac accuracies to 0.08% at one year are available. See the specifications that follow for complete information on measurement ranges and accuracy.

Powerful System Capabilities

Adding the inexpensive GPIB/IEEE-488* interface option to the 8840 Series provides system capability which includes complete system control of functions, ranges, and reading rates. Front and rear panel inputs are switch-selectable from the front panel (and you can sense the status of the switch over the bus). Calibration and self-test can also be controlled over the bus.

Powerful yet simple device dependent IEEE-488 code allows the 8840 Series DMMs to be easily integrated into your system. System software written for the 8840A is compatible with the 8842A and 8840A/AF.

The mechanical design also contributes to performance and convenience in system applications. The 8840A Series' metal case provides EMI shielding to ensure measurement integrity. The unit can be mounted in a half-rack slot simply by removing the handle, turning the "twist-away" rear feet, and bolting on rack mount brackets.

Embodying all these features, the 8840 Series DMMs are fully programmable, powerful digital multimeters within reach of every system builder.

Self-Testing

The 8840 Series automatically performs a digital self-test each time it is powered up. Additionally, you can initiate a comprehensive analog and digital diagnostic self-test from the front panel or through the IEEE-488 interface.

Closed-Case Calibration

No internal adjustments are required for calibration. After you initiate calibration via a recessed front panel switch, you are led through a software controlled procedure that even double checks to ensure that appropriate reference inputs have been applied. Calibration can be performed under front panel or GPIB/IEEE-488 control.

Technology

A monolithic A/D converter uses a proprietary CMOS IC designed to achieve the superb accuracy, speed, and reliability of the 8840 Series.

Analog switch ICs developed and manufactured by Fluke replace discrete switching devices to create superior performance, reliability, and serviceability.

A voltage reference device similar to that found in the Fluke 732B DC Reference Standard provides unmatched stability.

Precision thin film resistor networks establish the accuracy and maintain the stability of the 8840 Series.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

8842A Specifications

Technical Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5½ Digits	Resolution 5½ Digits	Resolution 4½* Digits	Input Resistance
20 mV	19.9999 mV	0.1 µV	1 µV	≥10,000 MΩ
200 mV	199.999 mV	1 µV	10 µV	≥10,000 MΩ
2V	1.99999V	10 µV	100 µV	≥10,000 MΩ
20V	19.9999V	100 µV	1 mV	≥10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

*4½ digits at the fastest reading rate

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts)

Range	24 Hour[1] 23±1°C	90 Day 23±5°C	1 Year 23±5°C	2 Year 23±5°C
20 mV[2]	0.0050 + 20	0.0070 + 30	0.0100 + 30	0.0120 + 40
200 mV[2]	0.0030 + 2	0.0045 + 3	0.0070 + 3	0.0100 + 4
2V	0.0015 + 2	0.0025 + 2	0.0030 + 2	0.0050 + 3
20V	0.0015 + 2	0.0030 + 2	0.0035 + 2	0.0060 + 3
200V	0.0015 + 2	0.0030 + 2	0.0035 + 2	0.0060 + 3
1000V	0.0020 + 2	0.0035 + 2	0.0045 + 2	0.0070 + 3

[1] *Relative to calibration standards*
[2] *Within one hour of dc zero, using offset control*

Medium and Fast Rates: In medium rate, add 3 counts (20 counts on 20 mV range) to number of counts. In fast rate, use two 4½ digit counts (30 counts on 20 mV range) for the number of counts

Operating Characteristics

Temperature Coefficient: >±(0.0006% of Reading + 0.3 Count) per °C from 18°C to 0°C and 28°C to 50°C
Maximum Input: 1000V dc or peak ac on any range
Noise Rejection: Automatically optimized at power-up for 50, 60 or 400 Hz

Rate	Readings/ Second[1]	Filter	NMRR[2]	Peak NM Signal	CMRR[3]
S	2.5[5]	Analog & Digital	>98 dB	20V or 2xFS[4]	>140 dB
M	20[6]	Digital	>45 dB	1xFS	>100 dB
F	100	None	–	1xFS	>60 dB

[1] *Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail.*
[2] *Normal Mode Rejection Ratio, at 50 Hz or 60 Hz ±0.1%. The NMRR for 400 Hz ±0.1% is 85 dB in S rate and 35 dB in M rate.*
[3] *Common Mode Rejection Ratio at 50 Hz or 60 Hz ±0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates.*
[4] *20V or 2 times Full Scale whichever is greater, not to exceed 1000V*
[5] *Reading rate – .31 rdg/sec in the 20 mV, 20Ω, 200 mA dc ranges*
[6] *Reading rate – 1.25 rdg/sec in the 20 mV, 20Ω, 200 mA dc ranges*

True-RMS AC Voltage Option (-09)

Input Characteristics

Range	Full Scale 5½ Digits	Resolution 5½ Digits	Resolution 4½* Digits	Input Resistance
200mV	199.999 mV	1 µV	10 µV	1 MΩ shunted by <100 pF
2V	1.99999V	10 µV	100 µV	
20V	19.9999V	100 µV	1 mV	
200V	199.999V	1 mV	10 mV	
700V	700.00V	10 mV	100 mV	

*4½ digits at the fastest reading rate

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts) for sinewave inputs ≥10,000 counts[1] (5% of range)

Freq (Hz)	24 Hour[2] 23 ±°C	90 Day 23 ±5°C	1 Year 23 ±5°C	2 Year 23 ±5°C
20-45	1.2 + 100	1.2 + 100	1.2 + 100	1.2 + 100
45-200	0.3 + 100	0.35 + 100	0.4 + 100	0.5 + 100
200-20k				
(200 mV)	0.06 + 100	0.08 + 100	0.10 + 100	0.20 + 100
(2-200V)	0.05 + 80	0.07 + 80	0.08 + 80	0.15 + 80
(700V)	0.06 + 100	0.08 + 100	0.10 + 100	0.20 + 100
20-50k	0.15 + 120	0.19 + 150	0.21 + 200	0.25 + 250
50-100k	0.4 + 300	0.5 + 300	0.5 + 400	0.5 + 500

[1] *For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz*
[2] *Relative to calibration standard*

Medium and Fast Reading Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 4½ digit counts and >100 Hz.
Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications

Fundamental Frequency	Crest Factor 1.0 - 1.5	Crest Factor 1.5 - 2.0	Crest Factor 2.0 - 3.0
45 Hz to 20 kHz	0.05%	0.15%	0.3%
20 Hz to 45 Hz & 20 kHz to 50 kHz	0.2%	0.7%	1.5%

Operating Characteristics

Maximum Input: 700V rms, 1000V peak or 2 x 10^7 volt-hertz product (whichever is less) for any range
Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz 20 - 20k	Frequency in Hertz 20k - 50k	Frequency in Hertz 50k - 100k
≥10,000 counts	0.019 + 9	0.021 + 9	0.027 + 10
≥1,000 counts	0.019 + 12	0.021 + 15	0.027 + 21

Common Mode Rejction: >60 dB at 50 Hz or 60 Hz with 1 kΩ in either lead

Current

Input Characteristics

Range	Full Scale 5½ Digits	Resolution 5½ Digits	Resolution 4½ Digit[1]
200 mA[2]	199.999 mA	1 µA	10 µA
2000 mA	1999.99 mA	10 µA	100 µA

[1] *4½ digits at the fastest reading rate*
[2] *200 mA range is dc only*

DC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Range	90 Day 23 ±5°C	1 Year 23 ±5°C	2 Year 23 ±5°C
200 mA	0.04 + 40	0.05 + 40	0.08 + 40
2000 mA			
≤1A	0.04 + 4	0.05 + 4	0.08 + 4
>1A	0.1 + 4	0.1 + 4	0.15 + 4

Medium and Fast Rates: In medium reading rate, add 2 counts (20 counts on 20 mA range) to number of counts. In fast reading rate, use two 4½ digit counts (20 counts on 200 mA range) for number of counts
AC Accuracy: (Requires Option -09)
Normal (S) Reading Rate: ±(% of Reading + Number of Counts) 23° ±5°C, for sinewave inputs ≥10,000 counts

Time	Frequency in Hertz 20-45	Frequency in Hertz 45-100	Frequency in Hertz 100-5k*
One Year	2.0 + 200	0.5 + 200	0.4 + 200
Two Years	3.0 + 300	0.7 + 300	0.6 + 300

*Typically 20 kHz

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 4½ digit counts and frequencies >100 Hz, the accuracy is ± (0.4 % of reading + 30 counts).
Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications

Fundamental Frequency	Frequency in Hertz 1.0 - 1.5	Frequency in Hertz 1.5 - 2.0	Frequency in Hertz 2.0 - 3.0
45 Hz to 5 kHz	0.05	0.15	0.3
20 Hz to 45 Hz	0.2	0.7	1.5

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specifications per °C from 0°C to 18°C and 28°C to 50°C
Maximum Input: 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse.
Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Current Through Unknown
		5½ Digits	4½[1] Digits	
20Ω[2]	19.9999Ω	0.1 mΩ	1 mΩ	1 mA
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1Ω	100 µA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 µA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 µA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 µA

[1] 4½ digits at the fastest reading rate
[2] 4-wire ohms only

Accuracy

Normal (S) Reading Rate: ± (% of Reading + Number of Counts)[1]

Range	24 Hour[2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C	2 Year 23 ±5°C
20Ω[3]	0.007 + 30	0.009 + 40	0.012 + 40	0.015 + 40
200Ω[3]	0.0040 + 3	0.007 + 4	0.010 + 4	0.012 + 4
2 kΩ	0.0025 + 2	0.005 + 3	0.008 + 3	0.010 + 3
20 kΩ	0.0025 + 2	0.005 + 3	0.008 + 3	0.010 + 3
200 kΩ	0.0025 + 2	0.006 + 3	0.010 + 3	0.012 + 3
2000 kΩ	0.023 + 3	0.025 + 3	0.027 + 3	0.030 + 3
20 MΩ	0.023 + 3	0.040 + 4	0.042 + 4	0.050 + 4

[1] Within one hour of ohms zero, using offset control
[2] Relative to calibration standards
[3] 4-wire ohms only

Medium and Fast Reading Rates: In medium rate, add 2 counts to the number of counts for the 200Ω through 200 kΩ ranges, 3 counts for the 2000 kΩ and 20 MΩ ranges, and 20 counts for the 20Ω range. In fast reading rate, use three 4½ digit for the number of counts for the 200Ω range, 20 4½ digit counts for the 20Ω range, and two 4½ digit for all other ranges.

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C

Measurement Configuration: 2-wire or 4-wire (20Ω range is 4-wire only)

Open Circuit Voltage: Less than 6.5V on the 20Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges.

Input Protection: To 300V rms

Reading Rates and Ranging

Reading Rates With Internal Trigger (readings per second)

Rate	Power Line Frequency[1]		
	50 Hz	60 Hz	400 Hz
S	2.08 (.26[2])	2.5 (.31[2])	2.38 (.30[2])
M	16.7 (1.04[2])	20 (1.25[2])	19.0 (1.19[2])
F	100	100	100

[1] Sensed automatically at power-up
[2] In the 20 mV, 20Ω, and 200 mA ranges. The 8842A does not autorange down into these ranges. To access these ranges, select the specific range, from the front panel or over the bus.

IEEE-488 Interface Option (-05)

Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, CT1, E1, PP0 and C0

General Specifications

Common Mode Voltage: 1000V dc or peak ac, or 700V rms ac from any input to earth ground

Temperature Range: 0°C to 50°C operating; -40°C to 70°C storage

Humidity Range: 80% RH from 0°C to 35°C; 70% to 50°C

Warmup Time: 1 hour to rated specifications

Power: 100V, 120V, 220V, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50 Hz, 60 Hz, or 400 Hz, automatically sensed at power up; 20 VA maximum

Vibration: Meets requirements of MIL-T-288000C for Type III, Class 3, Style E equipment

Safety: ANSI C39.5 and IEC 348, Class I, VDE 0411 Marks License, and CSA Bulletin 556B

Size: 89 mm H x 216 mm W x 371 mm L (3.5 in H x 8.5 in W x 14.6 in L)

Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)

Ordering Information

Models

8842A* Basic Digital Multimeter (DC only)
8842A/05 w/IEEE-488 Interface
8842A/09 w/True-RMS AC
8842A/059 w/IEEE-488 & True-RMS AC

** Option /09 or /059 needed to measure ac*

Included with Instrument

Two-year product warranty, line cord, TL70A test leads, Operator/Service Manual, IEEE-488 Quick Reference Guide, Performance Verification Record, and Certificate of Calibration Practices.

Options (for 8842A)

884XA-05K IEEE-488 Interface Field Kit
-09K* True-RMS AC Option Field Kit

** Requires recalibration*

Accessories (Also see Section 7)

Y8834 3½" Rack Mount Kit Single
Y8835 3½" Rack Mount Kit, Dual
Y8836 3½" Rack Mount Kit, Center
Y8021 IEEE-488 Shielded Cable, 1m
Y8022 IEEE-488 Shielded Cable, 2m
Y8023 IEEE-488 Shielded Cable, 4m
A90 6-Range Current Shunt

Manuals

8842A Getting Started*
8842A-IEEE-488 Ref. Guide*
8842A Operator & Service*

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty

Two-year product warranty.

8840A Specifications

Technical Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Input Resistance
		5½ Digits	4½* Digits	
200 mV	199.999 mV	1 µV	10 µV	≥10,000 MΩ
2V	1.99999V	10 µV	100 µV	≥10,000 MΩ
20V	19.9999V	100 µV	1 mV	≥10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

**4½ digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts)

Range	24 Hour[1] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200 mV[2]	0.003 + 3	0.007 + 4	0.008 + 4
2V	0.002 + 2	0.004 + 3	0.005 + 3
20V	0.002 + 2	0.005 + 3	0.006 + 3
200V	0.002 + 2	0.005 + 3	0.006 + 3
1000V	0.003 + 2	0.005 + 3	0.007 + 3

[1] Relative to calibration standards
[2] Using offset control

Medium and Fast Rates: In medium rate, add 2 counts. In fast rate, use three 4½ digit counts.

Operating Characteristics

Temperature Coefficient: >±(0.0006% of reading + 0.3 count) per °C from 18°C to 0°C and 28°C to 50°C

Maximum Input: 1000V dc or peak ac on any range

Noise Rejection: Automatically optimized at power-up for 50 Hz, 60 Hz or 400 Hz

Rate	Readings/ Second[1]	Filter	NMRR[2]	Peak NM Signal	CMRR[3]
S	2.5	Analog & Digital	>98 dB	20V or 2xFS[4]	>140 dB
M	20	Digital	>45 dB	1xFS	>100 dB
F	100	None	–	1xFS	>60 dB

[1] Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail.
[2] Normal Mode Rejection Ratio, at 50 Hz or 60 Hz ±0.1%. The NMRR for 400 Hz ±0.1% is 85 dB in S rate and 35 dB in M rate.
[3] Common Mode Rejection Ratio at 50 Hz or 60 Hz ±0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates.
[4] 20V or 2 times Full Scale whichever is greater, not to exceed 1000V

True-RMS AC Voltage Option (-09)

Input Characteristics

Range	Full Scale 5½ Digits	Resolution 5½ Digits	Resolution 4½* Digits	Input Resistance
200 mV	199.999 mV	1 μV	10 μV	1 MΩ shunted by >100 pF
2V	1.99999V	10 μV	100 μV	
20V	19.9999V	100 μV	1 mV	
200V	199.999V	1 mV	10 mV	
700V	700.00V	10 mV	100 mV	

**4½ digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts) for sinewave inputs ≥10,000 counts [1] (5% of range)

Frequency Hz	24 Hour[2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
20-45	1.2 + 100	1.2 + 100	1.2 + 100
45-100	0.3 + 100	0.35 + 100	0.4 + 100
100-20k	0.07 + 100	0.14 + 100	0.16 + 100
20k-50k	0.15 + 120	0.19 + 150	0.21 + 200
50k-100k	0.4 + 300	0.5 + 300	0.5 + 400

[1] *For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz*

[2] *Relative to calibration standards*

Medium and Fast Reading Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 4½ digit counts and >100 Hz

Operating Characteristics

Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz 20-20k	20k-50k	50k-100k
≥10,000 counts	0.019 + 9	0.021 + 9	0.027 + 10
≥1000 counts	0.019 + 12	0.021 + 15	0.027 + 21

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency conponents ≤100 kHz, add the following % of reading to the accuracy specifications

Fundamental Frequency	Crest Factor 1.0 - 1.5	1.5 - 2.0	2.0 - 3.0
45 Hz to 20 kHz	0.05%	0.15%	0.3%
20 Hz to 45 Hz & 20 kHz to 50 kHz	0.2%	0.7%	1.5%

Maximum Input: 700V rms, 1000V peak or 2 x 10^7 volt-hertz product (whichever is less) for any range

Common Mode Rejection: >60 dB at 50 Hz or 60 Hz with 1 kΩ in either lead

Current

Input Characteristics

Range	Full Scale 5½ Digits	Resolution 5½ Digits	Resolution 4½ Digit *
2000 mA	1999.99 mA	10 μA	100 μA

**4½ digits at the fastest reading rate*

DC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Range	90 Days 23 ±5°C	1 Year 23 ±5°C
≤1A	0.04 + 4	0.05 + 4
>1A	0.1 + 4	0.1 + 4

Medium and Fast Reading Rates: In medium reading rate, add 2 counts (20 counts on 20 mA range) to number of counts. In fast reading rate, use two 4½ digit counts (20 counts on 200 mA range) for number of counts.

AC Accuracy: (Requires Option -09)

Normal (S) Reading Rate: ±(% of Reading + Number of Counts) 23° ±5°C, for sinewave inputs ≥10,000 counts

Time	Frequency in Hertz 20-45	45-100	100-5k*
One Year	2.0 + 200	0.5 + 200	0.4 + 200

**Typically 20 kHz*

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 4½ digit counts and frequencies >100 Hz, the accuracy is ±(0.4% of reading + 30 counts).

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specifications per °C from 0°C to 18°C and 28°C to 50°C

Maximum Input: 2A dc or rms ac, protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse

Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale 5½ Digits	Resolution 5½ Digits	Resolution 4½ * Digits	Current Through Unknown
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1Ω	100 μA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 μA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 μA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 μA

**4½ digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rate: ± (% of Reading + Number of Counts)[1]

Range	24 Hour[2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200Ω[3]	0.004 + 3	0.011 + 4	0.014 + 4
2 kΩ	0.0028 + 2	0.01 + 3	0.013 + 3
20 kΩ	0.0028 + 2	0.01 + 3	0.013 + 3
200 kΩ	0.0028 + 2	0.01 + 3	0.013 + 3
2000 kΩ	0.023 + 3	0.027 + 3	0.028 + 3
20 MΩ	0.023 + 3	0.043 + 4	0.044 + 4

[1] *Using offset control*

[2] *Relative to calibration standards*

[3] *Applies to 4 wire ohms only*

Medium and Fast Reading Rates: In medium rate, add to the number of counts 2 counts for the 200Ω through 200 kΩ ranges and 3 counts for the 2000 kΩ and 20 MΩ ranges. In fast reading rate, use for the number of counts three 4½ digit counts for the 200Ω range and two 4½ digit counts.

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C

Measurement Configuration: 2-wire or 4-wire

Open Circuit Voltage: Less than 6.5V on the 20Ω through 200 kΩ ranges, less than 13V on the 2000 kΩ and 20 MΩ ranges

Input Protection: To 300V rms

Reading Rates

Reading Rates with Internal Trigger (readings per second)

Rate	Power Line Frequency* 50 Hz	60 Hz	400 Hz
S	2.08	2.5	2.38
M	16.7	20	19.0
F	100	100	100

** Sensed automatically at power-up*

IEEE-488 Interface Option (-05)

Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0

General Specifications

Common Mode Voltage: 1000V dc or peak ac, or 700V rms ac from any input to earth ground

Temperature Range: 0 to 50°C operating; -40°C to 70°C storage

Humidity Range: 80% RH from 0 to 35°C; 70% to 50°C

Warmup Time: 1 hour to rated specifications

Power: 100V, 120V, 220V, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50 Hz, 60 Hz, or 400 Hz, automatically sensed at power up; 20 VA maximum

Vibration: Meets requirements of MIL-T-28800C for Type III, Class 3, Style E equipment

Safety: ANSI C39.5 and IEC 348, Class I, VDE 0411 Marks License, and CSA Bulletin 556B
Size: 89 mm H x 216 mm W x 371 mm L (3.5 in H x 8.5 in W x 14.6 in L)
Weight: Net, 3.4 kg (7.5 lb); shipping, 5 kg (11 lb)

Ordering Information

Models

8840A* Basic Digital Multimeter (DC only)
8840A/05 w/IEEE-488 Interface
8840A/09 w/True-RMS AC
8840A/059 w/IEEE-488 & True-RMS AC

**Option /09 or /059 needed to measure ac*

Included with Instrument

One-year product warranty, line cord, TL70A test leads, Operator/Service Manual, IEEE-488 Quick Reference Guide, Performance Verification Record, and Certificate of Calibration Practices.

Options (for 8840A)
884XA-05K IEEE-488 Interface Field Kit
-09K* True-RMS AC Option Field Kit

**Requires recalibration*

Accessories (Also see Section 7)
Y8834 3½" Rack Mount Kit Offset, Single
Y8835 3½" Rack Mount Kit, Dual
Y8836 3½" Rack Mount Kit, Center
Y8021 IEEE-488 Shielded Cable, 1m
Y8022 IEEE-488 Shielded Cable, 2m
Y8023 IEEE-488 Shielded Cable, 4m
Y8077 Four Terminal Short
A90 6-Range Current Shunt

Manuals
8840A Getting Started*
8840A-IEEE-488 Quick Ref. Guide*
8840A Operator & Service*

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty

One-year product warranty.

8840A/AF Specifications

Technical Specifications

DC Voltage

Same specifications as 8840A except:
Maximum Input: 1000V dc or rms ac on any range

DC/DC Ratio

Input Characteristics

Range	Input Voltage		Reference Voltage	
	Full Scale	Input Resistance	Range	Input Resistance
200 mV	199.999 mV	>10,000 MΩ	+1V dc to +19.9999V	≥10,000 MΩ
2V	1.99999V	>10,000 MΩ		
20V	19.9999V	>10,000 MΩ		
200V	199.999V	10 MΩ		
1000V	1000.00V	10 MΩ		

Accuracy
+(% of Reading + Counts) for 1 year

Reference	Temperature
	20°C to 30°C
+10V <Vref <+20V	0.01 + 5
+1V <Vref <+10V	(0.01 + 5) x (10V/Vref)

Maximum Input: 1000V dc or rms ac on any range

Note: The Input LO terminal must be connected to the Reference LO terminal for correct operation.

Reading Rates
Readings per second (with Internal Trigger)

Rate	Power Line Frequency		
	50 Hz	60 Hz	400 Hz
S	1	1.2	1.1
M	5.4	6.5	6.1
F	12.6	12.6	12.6

True-RMS AC Voltage

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Input Resistance
		5½ Digits	4½* Digits	
200 mV	199.999 mV	1 µV	10 µV	1 MΩ shunted by <100 pF
2V	1.99999V	10 µV	100 µV	
20V	19.9999V	100 µV	1 mV	
200V	199.999V	1 mV	10 mV	
1000V	1000.00V	10 mV	100 mV	

**4½ digits at the fastest reading rate*

Accuracy
Normal (S) Reading Rates: ±(% of Reading + Number of Counts) for sine wave inputs ≥5% of range (10,000 counts[1])

Frequency Hz	24 Hour[2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
20-45	1.2 + 100	1.2 + 100	1.2 + 100
45-100	0.3 + 100	0.35 + 100	0.4 + 100
100-20k	0.07 + 100	0.14 + 100	0.16 + 100
20-50k	0.15 + 120	0.19 + 150	0.21 + 200
50-100k	0.4 + 300	0.5 + 300	0.5 + 400

[1] For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz
[2] Relative to calibration standards

Medium and Fast Reading Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 4½ digit counts and >100 Hz.

Operating Characteristics
Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz		
	20k-20k	20k-50k	50k-100k
≥10,000 counts	0.019 + 9	0.021 + 9	0.027 + 10
≥1000 counits	0.019 + 12	0.021 + 15	0.027 + 21

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications

Fundamental Frequency	Crest Factor		
	1.0 - 1.5	1.5 - 2.0	2.0 - 3.0
45 Hz to 20 kHz	0.05%	0.15%	0.3%
20 Hz to 45 Hz & 20 kHz to 50 kHz	0.2%	0.7%	1.5%

Maximum Input: 1000V rms or 2 x 10^7 volt-hertz product (whichever is less) for any range
Common Mode Rejection: >60 dB at 50 or 60 Hz with 1 kΩ in either lead

Current

Same specifications as 8840A

Resistance

Same specifications as 8840A

IEEE-488 Interface Option (-05)

Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0

General Specifications

Common Mode Voltage: 1000V dc or rms ac from any input to earth ground
Temperature Range: 0°C to 55°C operating; -62°C to 85°C storage
Humidity Range: 95% RH, +5% to 0%
EMI: Complies with CE01, CE03, CS01, CS02, CS06, and REO2 as specified in MIL-STD-461
Altitude: 4500m (15,000 ft) operating; 12,000m (40,000 ft) non-operating
Warmup Time: 1 hour to rated specifications
Power: 100V, 120V, 220V, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50 Hz, 60 Hz, or 400 Hz, automatically sensed at power up; 20 VA maximum
Vibration: Meets requirements of MIL-T-28800C for Type III, Class 3, Style E equipment
Safety: ANSI C39.5 and IEC 348, Class I, VDE 0411 Marks License, and CSA Bulletin 556B
Size: 89 mm H x 216 mm W x 371 mm L (3.5 in H x 8.5 in x W x 14.6 in L)
Weight: Net, 3.4 kg (7.5 lb); shipping, 5 kg (11 lb)

Ordering Information

Models

8840A/AF Digital Multimeter
8840A/AF/05 w/IEEE-488 Interface

Included with Instrument

One-year product warranty, line cord, TL70A test leads, Operator/Service Manual, IEEE-488 Quick Reference Guide, (with Option -05 only), Performance Verification Record, and Certificate of Calibration Practices.

Options (for 8840A/AF)
884XA-05K IEEE-488 Interface Field Kit

Accessories (Also see Section 7)
Y8834 3½" Rack Mount Kit Offset, Single
Y8835 3½" Rack Mount Kit, Dual
Y8836 3½" Rack Mount Kit, Center
Y8021 IEEE-488 Shielded Cable, 1m
Y8022 IEEE-488 Shielded Cable, 2m
Y8023 IEEE-488 Shielded Cable, 4m
Y8077 Four Terminal Short
A90 6-Range Current Shunt

Manual
8840A/AF Operator & Service*

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty

One-year product warranty.

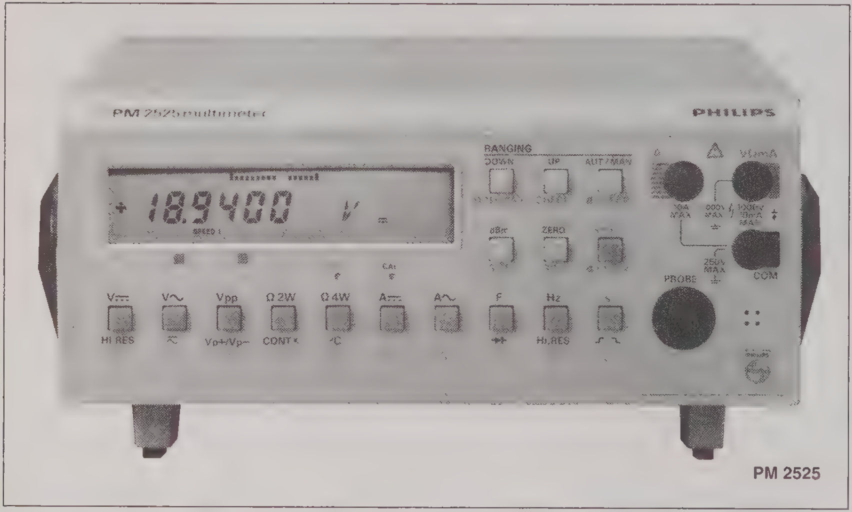
AVAILABLE THROUGH
DISTRIBUTORS

Indicates products except 8840A/AF and 8840A/AF/05 available through authorized Fluke distributors.

PM 2525

GPIB
IEEE-488

RS-232



PM 2525

PM 2525 Digital Multifunctional Multimeter

- 4¹/2 to 5¹/2 digit meter with 1 µV resolution (0.02% ±2 digits)
- More measurement functions (Hz, time, capacitance, temp, etc)
- Battery option for field use
- GPIB/IEEE-488, RS-232C and analog output options for system operation
- Simple command structure for system programming
- Comprehensive overload protection

PM 2525 Measurement Center

The PM 2525 is a very high specification instrument, offering a full range of standard DMM measurement features plus a range of unique extra functions, making it a complete "**measurement center.**"

Besides standard functions such as 8 current, 5 voltage and 7 resistance ranges, the PM 2525 also has the additional features of measurement of frequency, time, temperature, capacitance, dB and continuity.

For precision measurements the PM 2525 includes a 21,000 count facility plus a high resolution mode of 210,000 counts. This gives a resolution down to 1 µV for V dc; 100 pA for ac and dc current; 10 mΩ for resistance; and 1 pF for capacitance.

Bench, Battery or System Versions

The PM 2525 is available in five versions covering most applications:

1. **Basic benchtop model:** For use in laboratory, workshop and production environments.
2. **Battery model:** For field use. Rechargeable battery for 5 hours operation included.
3. **Instrument with an analog output:** For analog registration of the results.
4. **GPIB/IEEE-488* interface version:** For operation with IEEE systems.
5. **RS-232 instrument:** For operation with a computer.

The last two interface versions allow remote control of all instrument settings and downloading of measured values to a computer or system controller. These versions are supplied with special interface software which has the same command structure, in plain English, used by Fluke system multimeters. The instrument has an additional high speed mode which provides 3¹/2 digit V dc measurements at a rate of approximately 10 measurements/second.

Fast Result with Min/Max, Peak-Peak, dBm

A number of special measuring capabilities not only makes measurement easier but allows the user to reach conclusions faster. For practically all measurements the min/max function can be switched in. This function displays the maximum and minimum reading over a given period, for all measurement functions. Volt peak-peak gives the instant peak voltage. A selection can be made for positive, negative or peak-to-peak values. So, too, can adjustments be made more easily by using the dBm function.

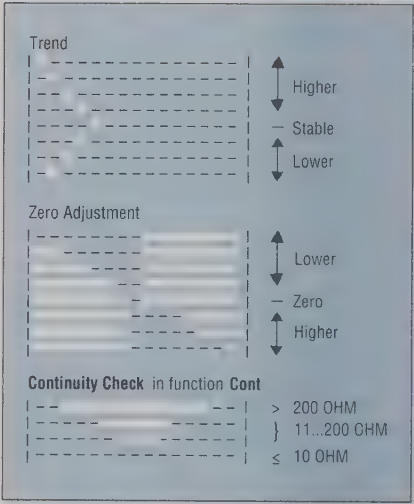
For both ac and dc voltage, the measurement can be read in dBm. And, since the reference resistance can be easily selected as well, levels can be quickly compared to a known reference.

More Functions, More Value

	Ranges	Resolution	Accuracy
V DC	5	1 µV	0.02%
V AC	5	10 µV	0.2%
VT RMS	5	10 µV	0.2%
V Peak-Peak	4	1 mV	1.0%
IDC	8	100 pA	0.1%
IAC	8	100 pA	0.4%
R (2-wire)	7	10 mΩ	0.1%
R (4-wire)	5	10 mΩ	0.1%
Hz	4	0.1 Hz	0.01%
Capacitance	6	1 pF	1.0%
Time	5	10 µsec	0.01%
Temperature	—	0.1°C	0.3%
Diode	—	100 µV	
dBm	5	0.1 dB	±0.4 dB

Trend Display with an Analog Bargraph

The PM 2525 has an analog bargraph display for optimal presentation of signal trends and precision detection of peak, through or null value, which is particularly valuable for peak tuning of communication equipment, for example. The rotating bargraph indicator on the LCD display steps in proportion to the voltage trend. With a 5V signal, the resolution is 0.01V per step, much higher than can normally be achieved with conventional analog multimeters.



Relative Measurements

Adjustments are easily made by presetting a value as a reference zero by a single touch of the zero-set button. Deviation, positive or negative from the set zero, is then immediately and clearly displayed. Also the bargraph function can be used in the same way so that the bargraph then acts as a very sensitive minus-null-plus indicator.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Overload Protection

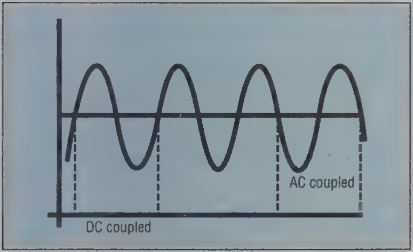
The PM 2525 also includes comprehensive overload protection. All voltage ranges can handle peak transients of up to 2.5 kV without damage, while all other ranges are protected against accidental connection to normal power supplies. The instrument is electronically protected on current ranges up to 1 mA and by a fuse for the 10 mA and 100 mA ranges. The 1A and 10A ranges have a separate input socket.

Current Measurement with Low Voltage Drop

For measurements up to 1 mA the PM 2525 is equipped with a unique current-compensation system that virtually eliminates voltage drops across the meter input, eliminating a common source of significant errors in low current measurements.

Choice of AC or DC Coupled True RMS Measurements

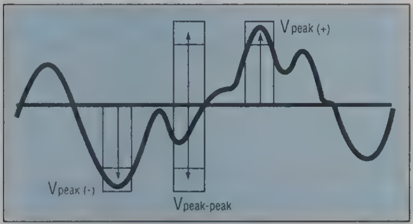
For accurate measurements of ac and ac + dc signal components regardless of the waveform.



True rms measurements are only possible with dc coupling since the dc component is an important part of the total signal energy. But ac coupling is essential for accurate measurements of ac components on large dc signals. The PM 2525 rms measurement function always gives accurate rms readings in both ac and dc coupled modes and even with highly distorted signal waveforms.

Accurate Measurement of Peak Values

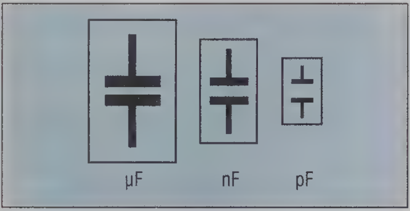
Direct measurement of positive, negative and peak-to-peak values over approximately 1 sec.



This function is valuable for measuring ignition or discharge voltages, as well as for measuring crosstalk between lines, and in electronic circuit design. In combination with min/max mode, the V p-p function allows the peak value of disturbances on a signal to be measured over an extended monitoring period.

Capacitance Measurements

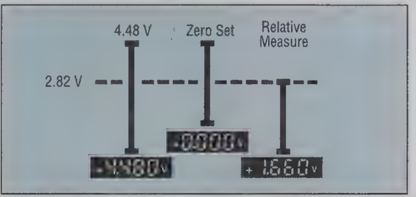
For measuring unknown devices or lead capacitances.



The PM 2525 capacitance function is unmatched in its class. The capacitance of any unknown device, or even of PCB tracks, can be measured directly in a wide range from 20 nF right up to 2000 µF, down to a resolution of 1 pF.

Simple Zero-Setting for Relative Measurements

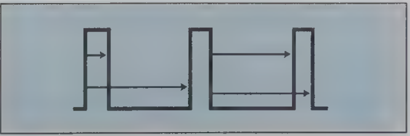
Direct measurement of tolerances or deviations from any preset value.



Zero-setting to use any value for relative reference measurements is done simply with the PM 2525, simply by pressing the ZERO button. This principle allows tolerance measurements, or component deviations from specified values, to be measured directly, and eliminates the need to make all measurements as absolute values.

Time and Frequency Measurements

Extra versatility through high-resolutions time and frequency functions.



One of the PM 2525 extra measuring capabilities is a useful time function with a range of up to 100,000s and a maximum resolution of 10 µs. Freely programmable start and stop edges enable all periods and pulse width measurements to be made in a repetitive or single trigger mode. By measuring time and the number of zero crossings the frequency of the input signal is calculated. Two different frequency measurements are possible. In the normal mode there is a resolution of 1 Hz, but in the 'High resolution' mode a resolution of 0.1 Hz can be achieved. Maximum frequency is 20 MHz.

Direct dB Read-Out

AC and dc voltages are shown as dB values to any zero reference level. And with user programmable reference resistance.

This function allows V ac and V dc measurements to be readout directly as dB values, saving time-consuming calculations. dB measurements are made against an absolute or selectable zero reference level. It is also possible to program a different reference resistance.

Direct dB read-outs are essential for measurements on amplifier gains and losses, or on communications equipment. The dB function can also be used in conjunction with the zero-set mode for 'end-to-end' amplifiers measurements.

Closed-Case, Electronic Calibration

The PM 2525 can be electronically calibrated and tested without opening the case, if the unit is equipped with an IEEE-488 or RS-232 interface. This function offers substantial time and cost savings and ensures that measurements are always made at optimum accuracy.

Simple Command Structure

The PM 2525/53x can be used within a system via its IEEE-488 bus interface. In such a system, procedures are programmed using a simple command structure which eliminates complex codes by using straight-forward English statements.

To ease communication with both user and computer, the PM 2525 accepts numeric ranging values in either decimal or exponential notation, and automatically rounds-off to the correct range. To overcome the often lengthy and complex task of splitting the numerical data from the output string, the PM 2525 has an "OUT N" command by which only the numeric value is transferred.

PM 2525

Specifications

Technical Specifications

Accuracy specifications are valid for 23°C±5°C

DC Voltage

Input Characteristics

Range	Full Scale (Hi Res)	Resolution		Input Resistance
		Norm	High	
200 mV	210.000 mV	10 µV	1 µV	20 MΩ
2V	2.10000V	100 µV	10 µV	20 MΩ
20V	21.0000V	1 mV	100 µV	11 MΩ
200V	210.000V	10 mV	1 mV	10 MΩ
2000V	1000.00V	100 mV	10 mV	10 MΩ

Accuracy: ±(0.02% reading + 2 counts)

For High resolution multiply # of counts by 10

Temperature Coefficient: ±0.002% reading/°C

Noise Rejection

NMRR 50/60 Hz	Peak NM Signal	CMRR		Maximum CM Signal
		DC	50/60Hz	
80 dB	2xRange	>120 dB	>120 dB	250V rms

Maximum Input: Hi to Lo, 1000V rms; Hi to Ground, 1000V rms; Lo to ground, 250V rms.

AC Voltage

Input Characteristics

Range	Full Scale	Resolution	Input Impedance
200 mV	210.00 mV	10 µV	20M/50 pF
2V	2.1000V	100 µV	20M/50 pF
20V	21.000V	1 mV	11M/80 pF
200V	210.00V	10 mV	10M/90 pF
2000V	750.00V	100 mV	10M/90 pF

Inputs <1% of range are displayed as zero.

Accuracy: (4½ digits) ±(%reading + counts)

Frequency	AC	AC+DC
200 mV to 200V Ranges		
20 Hz-40 Hz	0.6 + 40	0.8 + 60
40 Hz-100 Hz	0.2 + 20	0.4 + 40
100 Hz-20 kHz	0.8 + 40	1.0 + 60
20 kHz-50 kHz	2.5 + 100	2.7 + 120
50 kHz-100 kHz	4.0 + 100	4.2 + 120
2000V Range		
20 Hz-40 Hz	0.6 + 40	0.8 + 60
40 Hz-70 Hz	0.2 + 20	0.4 + 40

Temperature Coefficient: ±(0.03% reading + 1 count)/°C
Maximum Input: 750V rms or 10^7 Volt-Hertz Product
CMRR: > 60 dB for 50/60 Hz
Crest Factor: 2 at Full Scale, increasing down scale by 2 x Full Scale/Reading

Current

Input Characteristics

Range	Full Scale	Resolution	Protection	Burden
1 µA	1.1000 µA	0.1 nA	250V rms	<2.5 mV
10 µA	11.000 µA	1 nA		<2.5 mV
100 µA	110.00 µA	10 nA		<40 mV
1 mA	1.1000 mA	100 nA	Fused 630 mAF 250V rms	<400 mV
10 mA	11.000 mA	1 µA		<40 mV
100 mA	110.00 mA	10 µA		<400 mV
1A	1.1000A	100 µA	-	<40 mV
10A	10.000A	1 mA		<400 mV

Maximum Input: 250V rms
Maximum CM Voltage: 250V rms, 350V peak

DC Current

Accuracy: ±(0.1% reading + 5 counts)
Temperature Coefficient: ±(0.01% reading +0.5 count)/°C

AC Current

Accuracy: ±(% reading + counts)

Frequency	Range	
	1µA to 100mA	1A & 10A
20 Hz - 40 Hz	0.6 + 20	0.6 + 20
40 Hz - 200 Hz	0.4 + 15	0.4 + 15
200 Hz - 500 Hz	0.6 + 20	3.0 + 100

Between 5% and 100% of range
Measured Value <2% of range is displayed as 0

Temperature Coefficient: ±(0.04% reading +1.5 count)/°C

Resistance

Input Characteristics

Range		Full Scale	Resolution	Source Current
4-Wire*	2-Wire			
200Ω	200Ω	210.00Ω	10 mΩ	1 mA
2 kΩ	2 kΩ	2.1000 kΩ	100 mΩ	1 mA
20 kΩ	20 kΩ	21.000 kΩ	1Ω	100 µA
200 kΩ	200 kΩ	210.00 kΩ	10Ω	10 µA
2 MΩ	2 MΩ	2.1000 MΩ	100Ω	1 µA
	20 MΩ	21.000 MΩ	1 kΩ	100 nA
	200 MΩ	210.0 MΩ	100 kΩ	10 nA

**Via Probe Input Only.*

Accuracy: ±(% reading + counts)

Range	Accuracy	Temp. Coeff
200 2k 20k 200k	0.1 + 10	0.01 + 1
2M 20M	0.5 + 10	0.05 + 2
200M	3.0 + 20	0.5 + 2

Open Circuit Voltage: <4V
Maximum Input Voltage: 250V rms

Peak Voltage

Input Characteristics

Range	Resolution	Accuracy **		Max Slew Rate
		DC & 20 Hz-20 kHz	20-100 kHz	
2V	1 mV	1.0 + 10	5.0 + 10	<2V/µs
20V	10 mV	1.0 + 10	5.0 + 10	<20V/µs
200V	100 mV	1.0 + 10	5.0 + 10	<200V/µs
2000V*	1V	1.0 + 1*	-	<0.5V/µs

** Limited to maximum frequency of 60Hz*
*** ±(% reading + number of counts)*

Temperature Coefficient: 0.15% reading/°C
Measurement Time: 500 ms
Minimum Pulse Width: 5 µs
Maximum Volt-Hertz Product: 10^7
CMRR: >120 dB for dc, >60 dB for ac
Maximum Input: 600V rms, 850V peak/peak

Capacitance

Range	Resolution	Accuracy %rdg+count	Temp.Coeff %rdg+count	Source Current
20 nF	1 pF	1.0 + 20	0.1 + 2	100 nA
200 nF	10 pF	1.0 + 20	0.1 + 2	1 µA
2 µF	100 pF	1.0 + 20	0.1 + 2	10 µA
20 µF	1 nF	1.0 + 20	0.1 + 2	100 µA
200 µF	10 nF	1.0 + 20	0.1 + 2	1 mA
2000 µF	1 µF	10.0 + 20	1.0 + 20	1 mA

Maximum Voltage at Input: <2.5V
Maximum Input Voltage : 250V rms

Diode

Range: 2000.0 mV
Resolution: 0.1 mV
Source Current: 1 mA
Maximum Input Voltage: 250V rms

Continuity

Source Current: 1 mA
Short Circuit: Audible Tone (0 to 10Ω)
Open Circuit: No Tone (>10Ω)

Temperature*

Range: -100°C to 850°C
Resolution: 0.1°C
Accuracy: ±(0.3% reading + 0.3°C)
Temperature Coefficient: ±(0.03% reading + 0.03°C)/°C
Source Current: 1 mA
Linearization: Probe characteristic is linearized within limits stated by DIN 43760.

** An additional PM 9248/01 Temperature Probe or Pt100 element is required.*

dB Measurements

0dB Reference: 1 mW (Rref 600Ω)
Rref: Programmable from 0.1 mΩ to 9999Ω
Resolution: 0.1 dB (1 dB if < 1 mV)
CMRR: >120 dB for dc Signals

PM 2525

DC Ranges

Input Voltage	dBm 600 Ohm	Range	Accuracy
0.1 mV to 1 mV	-77 to -57	200 mV	1 dB
1 mV to 200 mV	-57.7 to -11.7	200 mV .1 dB	1 dB (<5 mV) (>5 mV)
200 mV to 2V	-11.7 to 8.2	2V	0.1 dB
2V to 20V	8.2 to 28.2	20V	
20V to 200V	28.2 to 48.2	200V	
200V to 1000V	48.2 to 62.2	2000V	

AC Ranges

Input Voltage	dBm 600Ω	Range	Accuracy 20 Hz 20 kHz 100 kHz	
2mV to 6mV	-51.7 to -42.2	200 mV	Not Specified	
6 mV to 18 mV	-42.2 to -32.6		0.8 dB	Not Specified
18 mV to 200 mV	-32.6 to -11.7		0.1 dB	1 dB
200 mV to 2V	-11.7 to 8.2	2V		
2V to 20V	8.2 to 28.2	20V		
20V to 200V	28.2 to 48.2	200V		
200V to 750V	48.2 to 62.2	2000V	Not Specified	

Frequency

Input Characteristics

Range	Full Scale (Hi Res)	Resolution		Accuracy*
		Norm	High	
10 kHz	10.0000 kHz	1 Hz	0.1 Hz	0.01 + 2
100 kHz	100.000 kHz	10 Hz	1 Hz	0.01 + 2
1 MHz	1.00000 MHz	100 Hz	10 Hz	0.01 + 2
10 MHz	10.0000 MHz	1 kHz	100 Hz	0.01 + 2
20 MHz	20.000 MHz	10 kHz	1 kHz	0.01 + 2

**±(% reading + number of counts)*

Temperature Coefficient: ±0.001% reading/°C
Coupling: AC
Sensitivity: 10 Hz to 100 Hz, 1V peak; 100 Hz to 10 MHz, 250 mV peak; 10 to 20 MHz, 500 mV peak.
Maximum Input Voltage: 250V rms

Time

Input Characteristics

Range	Full Scale	Resolution Norm	Accuracy ±(%Rdg)	Temp.Coeff ±(%Rdg)/°C
1s	.99999s	10 µs	0.01	0.001
10s	9.9999s	100 µs	0.01	
100s	99.999s	1 ms	0.01	
1000s	999.99s	10 ms	0.01	
10000s	9999.9s	100 ms	0.01	
100000s	99999s	1s	0.01	

Measurement Response Times*

Function & Range	Ranging	
	No	Yes
DC Voltage	0.8	1.5
AC Voltage	1.5	3.0
DC Current	0.8	2.5
AC Current	1.5	3.0
Resistance 200 to 200 kΩ	0.8	2.5
Resistance 2M & 20 MΩ	2.0	3.5
Resistance 200 MΩ	9.0	10.0
Peak Voltage	1.0	2.5
Peak/Peak Voltage	1.5	5.0
Capacitance	1.0	1.5
Diode	0.8	-
Continuity	<0.15	-
Temperature	0.5 **	-
dB (DC Mode)	1.5	-
dB (AC Mode)	3.0	-
Frequency (10 kHz)	1.5	-
Frequency (10 kHz - 20 MHz)	0.3	0.5

** All times expressed in seconds for normal measurement speed*
*** Excluding probe response time*

Battery Option

Operating Time (Full Charge): >5 Hours
Charge Time: <15 Hours
Low Battery Indication: On Display

GPIB/IEEE-488 Interface

Allows complete control and data output capability and supports the following interface function subsets: SH1, AH1, T5, SR1, RL1, DC1, DT1.

RS-232C Serial Interface

Baud Rates: 110 to 9600
Stop Bits: 1 or 2
Data Bits: 7 or 8
Parity: Odd, Even or None

Analog Output

Allows selective monitoring of part of the display.
Output Voltage: 0 to 1V
Accuracy: ±0.25% of reading ± 0.25% of range
Temperature Coefficient: ±(0.025% reading + 0.01% range)/°C
Output Resistance: 200Ω

General Specifications

Temperature Range: 0 to 40°C operating; -40°C to +70°C Storage
Humidity: 20% to 80% non condensing
Power: 98V to 129V, 60 Hz or 196V to 258V 50 Hz; 12 VA Max
Safety: IEC 348 Class II
Calibration Interval: 1 Year
Size: 8.6 cm H x 21.0 cm W x 28.7 cm D (3.4 in H x 7.3 in W x 11.3 in D) 10.6 cm H (including Feet)
Weight: 2.5 kg (5.5 lb)

Ordering Information

Models

PM 2525/03n Basic Digital Multimeter
PM 2525/23n DMM with Battery Pack
PM 2525/53n DMM with IEEE-488 Interface
PM 2525/63n DMM with RS-232C Interface
PM 2525/73n DMM with Analog Output

The n' indicates the required line cord. To select your line cord substitute the n' by:

1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

Included with Instrument
One-year product warranty, test leads and operator manual.

Accessories (Also see Section 7)
HM 9606/00 5" Rack Mount Kit for 1 x PM 2525 & 1 x PM 6666 Counter
HM 9606/02 5" Offset Rack Mount Kit for PM 2525 only
PM 2193/02 5" Rack Mount Kit
PM 2194/02 Blank Panels for PM 2193/02
83RF High Frequency Probe
PM 9244 AC/DC Current Shunt
PM 9245 AC Current Transformer
PM 9249/01 Pt 100 Temperature Probe
PM 9264/01 4-Wire Resistance Measurement Cable
PM 9266/03 Safety Test Leads with Probes
PM 9267/01 Data Hold Probe
PM 9877J/2 Thermocouple Linearizer
PM 9877K/2 Thermocouple Linearizer

Manuals
PM 2525 Operator*
PM 2525 Programming Card
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

8505A & 8506A

GPIB
IEEE-488

RS-232

(NSN 6625-01-126-3154) **8505A**
(NSN 6625-01-234-4134) **8506A**

8505A Digital Multimeter

- 5 ppm dc accuracy, 100 nV (nanovolt) sensitivity
- 500 readings per second with 6½ digit resolution
- AC (8505A only), ohms, current module options
- GPIB/IEEE-488, RS-232C, and parallel interfaces
- Front-rear switchable input standard in basic mainframe
- Software calibration from front panel or remote interface
- Modular construction for application flexibility

8506A Thermal RMS Digital Multimeter

- 8505A features plus
- 120 ppm 24-hour ac accuracy, 40 Hz to 20 kHz
- Full accuracy for crest factors as high as 8:1
- 25 ppm short-term ac stability
- Frequency response specified to 1 MHz
- AC-DC transfer accuracies with DMM speed and convenience

The 8505A and 8506A Digital Multimeters are Fluke's most advanced bench/system DMMs. Both models excel in dc accuracy, resolution, versatility and speed.

The 8506A uses a fast thermal rms sensing technique for measuring ac which very significantly advances the state-of-the-art for ac measurements using a system DMM. It is several times more accurate than the calculating type of true-rms converter and is unmatched by any other DMM. Basic ac accuracy uncertainty is reduced to 120 parts per million, 24 hours for frequencies from 40 Hz to 20 kHz. That approximates the accuracy you can expect using traditional thermal transfer techniques that typically take several minutes for each measurement. Short term stability is 25 ppm. Accuracy is specified from 10 Hz to 1 MHz and non-sinusoidal waveforms having crest factors as high as 8 to 1 can be measured with full 90-day accuracy.

Software Calibration

Both the 8506A and 8505A have a "software calibration" feature that makes it easy to store correction factors for every range of any measurement function. You can update the 24-hour accuracy specifications daily, or whenever the need arises without having to remove the covers. Nor do you need to use a cardinal point standard for a reference. Any reference having a suitably accurate value between 60% of range and full scale will do. This "software calibration" is managed with a few keystrokes on the front panel or even remotely when used as part of a test and measurement system.

Measurement Speed

Most system DMM manufacturers use an integrating technique for A-to-D conversion. That means there must be a compromise between resolution and reading speed. The 8505A and 8506A use a Fluke patented "recirculating remainder" technique for A-to-D conversion that does not compromise 6½ digit resolution at reading speeds up to 500 per second for dc voltage measurements. Front or rear measurement inputs are switch-selectable from the front panel. For system applications the position of the switch can be sensed through the interface. An external trigger input is included to control the timing of measurements remotely. And, to control the switching time of an external scanner, scanner-advance output pulses are available at the rear panel.

Either GPIB/IEEE-488*, RS-232C, or an 8-bit/16-bit parallel interface option may be used for systems applications. The parallel interfaces will work with DEC computer interfaces DR11C or DRV11.

Math Power

The 8506A and 8505A are controlled by an internal microprocessor and have built-in math power to add, subtract, multiply, and divide as well as store and compare numerical information. Each measurement may be made a part of a calculation before being displayed or recorded. Stored HI and/or LO limit values may be repeatedly compared to measured values to determine out-of-tolerance conditions, HI, LO, or PASS indications may appear directly in the display. The highest and lowest values in a series of measurements may be stored and later dis- played. And measurements may all be in terms of ± deviations from a stored "offset" value. In general, any calculation is possible based on the general formula.

$Y = mx+b$
Where m = scaling factor (multiplier),
x = value measured,
b = the ± offset, and
Y = the numerical result

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

8506A & 8505A Differences

The 8505A is Fluke's lowest cost DMM having top dc accuracy, resolution, and speed. Two options for measuring ac voltage are available, either an ac average-sensing, rms-indicating option (-01) for sinewaves or an ac true-rms option (-09A) for either sinewaves or non-sinusoidal waveforms. An option for measuring current (-03) and an option for measuring resistance (-02B) are also available for the 8505A. For measuring ac current, an ac voltage option (-01 or 09A) must also be installed. An 8505A, when fully equipped, will measure dc and ac voltage, dc and ac current, and resistance.

The 8506A and 8505A have identical dc measurement capabilities but the 8506A requires no option for measuring ac voltage. State-of-the-art ac voltage measurement capabilities are built in. An option for measuring dc current may be installed (-03) or an option for measuring resistance may be installed (-02B), but not both at the same time. Any external dc reference voltage up to 40 volts that is applied at the rear panel may be compared and the relative values displayed as a ratio. The same interface options are available for the 8506A as for the 8505A.

8506A Specifications

Technical Specifications

DC Voltage

All dc voltage accuracy and stability specifications apply after a two-hour warm-up unless otherwise noted. The 24-hour specifications are relative to the calibration standards used.

Input Characteristics

Range	Full Scale 6½ Digits	Resolution 7½* Digits	6½ Digits	Input Resistance
100 mV	200.0000 mV	–	100 nV	≥10,000 MΩ
1V	2.000000V	–	1 µV	≥10,000 MΩ
10V	20.00000V	1 µV	10 µV	≥10,000 MΩ
100V	128.0000V	–	100 µV	10 MΩ
1000V	1200.000V	–	1 mV	10 MΩ

In AVG operating mode

Accuracy, Normal Mode, 6½ Digits: ±(% of Rdg + Counts)

Range	24 Hours* 23°C ±1°C	Long Term 18°C to 28°C: Up to 90 Days	Add Per Mo Over 90 Days
100 mV	0.0018+15	0.0025+40	0.00017+5.6
1V	0.0008+7	0.0015+8	0.0001+0.1
10V	0.0006 or 6**	0.0010+8	0.0001+0.1
100V	0.0010+6	0.0018+8	0.00013+0.1
1000V	0.0008+6	0.0018+8	0.00013+0.1

** After 4-hour warm-up & within 1 hour of zeroing dc*
***Whichever is greater*

Accuracy, AVG Mode, 6½ Digits: ±(% of Rdg + Counts)

Range	24 Hours* 23°C ±1°C	Long Term 18°C to 28°C: Up to 90 Days	Add Per Mo Over 90 Days
100 mV	0.0010+8	0.0020+8	0.0001+0.1
1V	0.0005+4	0.0012+6	0.0001+0.1
10V	0.0005 or 50***	0.0008+60**	0.00008+1**
100V	0.0005+5	0.0015+6	0.0001+0.1
1000V	0.0005+5	0.0015+6	0.0001+0.1

**After 4-hour warm-up & within 1 hour of zeroing dc*
***7½ digit mode of operation*
**** Whichever is greater*

Accuracy, Software Calibration

Fully restores above "24-hour" accuracy for 24 hours each time performed within 30 days after hardware calibration is performed. After 30 days add the following number of counts to the 24-hour accuracy specifications.

Time Since Internal (Hardware) Calibration	Number of Counts to be Added: 6½ Digits	7½ Digits
Less than 30 Days	0	0
30 to 90 Days	1	10
90 Days to 1 Year	2	20
More than 1 Year	3	30

Temperature Coefficient

±(% of Rdg + Counts)/°C

Range	0°C to 18°C and 28°C to 50°C
100 mV	0.0003+5
1V	0.0003+1
10V	0.0002+0.5*
100V	0.0003+1
1000V	0.0003+0.5

**With 6½ digit display. For 7½ digit display, multiply Number of Counts by 10.*

Input Bias Current

At Time of Adjustment	1 Year 23°C ±1°C	Temperature Coefficient
<±5 pA	<±30 pA	<±1 pA/°C

Zero Stability: Less than 5 µV for 90 days after a four-hour warm-up. Front panel pushbutton zero is provided for permanent storage of a zero correction for each range. Zero may be turned off at any time.

Normal Mode Rejection

Line Frequency	Filter Mode	4 Samples Per Reading	32 Samples Per Reading	128 Samples Per Reading
50 Hz	Fast	60 dB	70 dB	75 dB
50 Hz	Slow	85 dB	90 dB	95 dB
60 Hz	Fast	60 dB	70 dB	75 dB
60 Hz	Slow	90 dB	95 dB	100 dB

Common Mode Rejection: 160 dB at 60 Hz with 1 kΩ in series with either lead, and 4 samples or more per reading. Greater than or equal to 100 dB with less than 4 samples per reading.

Analog Settling Time

Filter Mode	Filter Command	To 0.01% of Step Change	To 0.001% of Step Change
Fast	F0 or F3	40 ms	50 ms
Slow	F or F2	400 ms	500 ms

Digitizing Time (Line Synchronous): For 2^0 to 2^{17} samples per reading the digitizing time is from 4 ms to 9 minutes 6 seconds using a 60 Hz line. Time increases 20% using 50 Hz ac line. Selectable in 18 binary steps.
Digitizing Time (Line Asynchronous): 2 ms in 3-byte binary mode with dc zero, offset, limits and calibration factors turned off
Maximum Input: ±1200V dc or 1000V rms ac to 60 Hz, or 1400V peak above 60 Hz may be applied continuously to any dc range without permanent damage. Maximum rate of voltage change is 1000V per µs.

Ratio (External DC Reference)

Voltage, resistance, or current may be measured and compared to an external dc voltage and displayed as a ratio. Option -02B or -03 is required when measuring resistance or current. The dc reference voltage (V_{xref}) is applied to terminals on the back panel and is the denominator of the ratio.
Input Resistance: >10,000 MΩ between Ext Ref HI and LO and between either Ext Ref HI or LO and Ohms Guard or Sense LO
Maximum Reference Voltage: ±40V between Ext Ref HI and LO terminals providing neither terminal is greater than ±20V relative to the Sense LO or Ohms Guard terminal
Minimum Reference Voltage: ≥0.0001V when comparing voltage or current, and ≥0.0001V or 1 billionth of the absolute value of resistance, whichever is greater, when comparing resistance
Maximum Ratio Display: 10^{-9} to 10^{9}
Source Impedance: Resistive unbalance (Ext Ref HI to LO) <4 kΩ. Total resistance to Sense LO from either Ext Ref HI or LO <20 kΩ.
Overload Voltage: ±180V dc or peak ac relative to Ohms Guard or Sense LO. ±360V dc or peak ac (Ext Ref HI to LO).
Normal Mode Noise Rejection: ≥100 dB for line frequency and 2x line frequency
Common Mode Noise Rejection: ≥75 dB for dc, line frequency, and 2x line frequency

8505A & 8506A

Ratio Accuracy

External Reference Voltage	Accuracy
±20V to ±40V	±(A + B + 0.001%)
$\pm V_{min}$ to ±20V	$\pm(A + B + (0.02\%/ \lvert V_{xref} \rvert))$

A = 10V dc range accuracy for the appropriate period of time

B = Input signal function and range accuracy for the appropriate period of time

V_{min} = *Minimum allowable external reference voltage*

$\lvert V_{xref} \rvert$ = *Absolute value of the external reference voltage*

Digitizing Time: 196 ms to 9 minutes 6s for 2^0 to 2^{17} samples per reading using 60 Hz line, increasing 20% using 50 Hz line

AC Voltage (Thermal RMS)

All ac voltage accuracy and stability specifications for 5½ digit displays using at least 25% of full scale after a 2-hour warm-up. Except where noted, ac coupling is used to block dc. The 24-hour specifications are relative to the calibration standards used and within 1 hour of dc zero.

Range	Full Scale 5½ Digits	Resolution		Input Impedance
		6½* Digits	5½ Digits	
100 mV**	125.000 mV	–	1µV	1 MΩ ±1% shunted by <180 pF
300 mV	400.000 mV	–	1 µV	
1V	1.25000V	1 µV	10 µV	
3V	4.00000V	1 µV	10 µV	
10V	12.5000V	10 µV	100 µV	
30V	40.0000V	10 µV	100 µV	
100V	125.000V	100 µV	1 mV	
500V	600.000V	100 µV	1 mV	

**In AVG operating mode*

***10% of full scale, min. specified level is 12.5 mV ac*

Settling Time

High Accuracy Mode: Sample time is 3.5 seconds, hold time is 2.5 seconds. Measurement time is 6 seconds – the sum of sample time and hold time. If the state of the instrument is unknown, two complete measurement cycles will be required to guarantee a correct reading. Use of an external trigger will allow a 6-second measurement cycle.

Enhanced Mode: The first reading requires the same time as the high accuracy mode. Subsequent readings occur every 500 milliseconds. If the input changes 0.1% the analog settling time to 90-day mid-band accuracy is 1.5 seconds.

Normal Mode: Settling time for large changes is non-linear. Zero to full scale changes require 2.0 seconds to settle to 90-day, mid-band specifications. Full scale to 10% of full scale changes require 3.0 seconds to settle to mid-band, 90-day specifications. Small changes (<1%) settle to mid-band specifications in <1.5 seconds.

Autoranging: Upranges when input is higher than full scale. Downranges when reading is less than approximately 28% of full scale.

Accuracy, High-Accuracy Mode: ±(% of Reading)[1] 24 Hours, 23°C ±1°C[2]

Ranges	Frequency in Hertz						
	10** to 40	40 to 20k	20k to 50k	50k to 100k	100k to 200k	200k to 500k	500k to 1M[4]
100 mV	0.08	0.02*	0.04*	0.2	0.6	1.5	3.5
300 mV to 10V	0.08	0.012	0.04	0.2	0.5	1.5	3.5
30V	0.08	0.012	0.04	0.2	0.5	3.5	12
100V	0.08	0.012	0.04	0.2	1.0	3.5	–
500V[3]	0.09	0.014	0.046	0.23	–	–	–

90 Days, 18°C to 28°C

100 mV	0.08	0.026*	0.06	0.2	0.6	1.5	3.5
300 mV to 10V	0.08	0.016	0.06	0.2	0.5	1.5	3.5
30V	0.08	0.016	0.06	0.2	0.5	3.5	12
100V	0.08	0.016	0.06	0.2	1.0	3.5	–
500V[3]	0.09	0.018	0.069	0.23	–	–	–

>90 Days, 18°C to 28°C, per month. Add to the 90-day specification the following % of reading.

All	0.008	0.001	0.0025	0.012	0.021	0.06	0.11

**Add 5 digits (5 µV) to the % of reading*

***With Slow filter*

Accuracy, Enhanced Mode: Add the following (% of reading + number of digits) to the accuracy specifications of the high accuracy mode –

Ranges	Time Since First Reading	
	<5 Min	>5 and <30 Min
All except 500V	0 + 0	0.003 + 4
500V	0 + 0	0.003 + 6

Accuracy, Normal Mode: Add the following % of reading to the accuracy mode specification of the high accuracy mode –

Segment of Scale	24 Hour 90 Day	>90 Day Add Per Month
0.25 x to 1 x full scale	0.4	0.044
0.1 x to 0.25 x full scale	0.6	0.055

DC-Coupled (AC+DC) Accuracy: ±(1.1 times the appropriate ac-coupled specifications + a calculated "Adder" from the following table)

Range	Adder
100 mV-1V	±(150 µV x (dc volts/total rms volts))
3V & 10V	±(1 mV x (dc volts/total rms volts))
30V & 100V	±(10 mV x (dc volts/total rms volts))
500V	±(50 mV x (dc volts/total rms volts))

Stability: 40 Hz to 20 kHz, <1°C Temperature Change

Range	±(% of Rdg + Counts)*	
	24 Hours	90 Days
100 mV, 1V, 10V, 100V	0.0025 + 1	0.004 + 1
300 mV, 3V, 30V	0.0025 + 3	0.004 + 4
500V	0.0025 + 5	0.004 + 6

**For 5½ digit resolution*

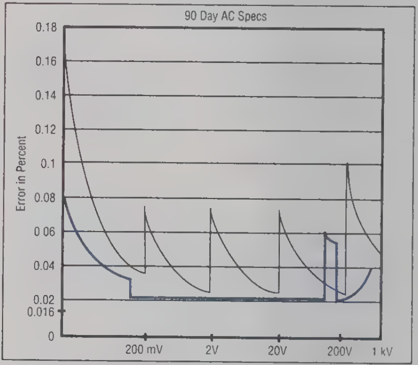
Crest Factor: Up to 8:1, with 90-day or greater accuracy for input signals with peaks less than two times full scale and high frequency components within the 3 dB bandwidth. Up to 4:1 for signals with peaks less than four times full scale, with the addition of 0.03 to the percent-of-reading specification.

3dB Bandwidth (Typical): 3 MHz for the 100 mV range and 10 MHz for the 300 mV, 1V, 3V and 10V ranges

Maximum Input Voltage: ±600V dc or rms ac, 840V peak, or 1×10^7 volt-hertz product

Temperature Coefficient: One tenth of the 90-day accuracy specification per °C from 18°C to 0°C or 28°C to 50°C

Common Mode Rejection: >120 dB from dc to 60 Hz with 100Ω in series with either lead



This graph compares the total ac uncertainty of the 8506A's thermal rms converter to that of a typical computing rms converter used in other DMMs. The effects of floor error which cause large uncertainties at the beginning of each range are non-existent in the 8506A from 125 mV ac to 125V ac.

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[1] *AC coupled, 5½ digits, input level >0.25 x full scale. For 6½ digits multiply Number of Counts by 10. For input levels between 0.1 x and 0.25 x full scale, add 5 counts for the 100 mV, 1V, 10V, and 100V ranges, add 15 counts for the 300 mV, 3V, 30V ranges, and add 25 counts for the 500V range.*

[2] *Relative to calibration standards, within 1 hour of dc zero.*

[3] *Add 0.02 x (Input voltage/600)^2 % of Reading to the specification.*

[4] *For input frequencies >700 kHz add 1.5% to the 300 mV and 3V specification.*

8506A Option Specifications

Resistance Option (-02B)

All resistance accuracy and stability specifications apply after a 2-hour warm-up. The 24-hour specifications are relative to the calibration standards used.

Input Characteristics

Range	Full Scale 5½ Digits	Resolution*		Current Through Unknown
		6½* Digits	5½ Digits	
10Ω	20.0000Ω	10 μΩ	100 μΩ	10 mA
100Ω	200.0000Ω	100 μΩ	6½ Digits Only	10 mA
1kΩ	2.000000kΩ	1 mΩ		1 mA
10 kΩ	25.0000 kΩ	10 mΩ		78 μA
100 kΩ	250.000 kΩ	100 mΩ		7.2 μA
1 MΩ	4.10000 MΩ	1Ω	10Ω	4.5 μA
10 MΩ	35.0000 MΩ	10Ω	100Ω	0.45 μA
100 MΩ	265.000 MΩ	100Ω	1 kΩ	56 nA

*In normal operating mode, 5½ or 6½ digits depending on range. In AVG operating mode, 6½ digits on all ranges.

Open Circuit Voltage: 7V maximum from 10Ω through 100 kΩ range; 25V maximum from 1 MΩ range through 100 MΩ range

Maximum Input: ±400V dc or peak ac, continuous on any range with no damage

Analog Settling Time: 80 ms with Fast filter or 800 ms with Slow filter, to rated accuracy

Digitizing Time: Depending on sample rate and filter selection the digitizing time will vary from 145 ms to 9 minutes 6 seconds using a 60 Hz ac line. Time increases 20% using a 50 Hz line.

Accuracy, 6½ Digits: ±(% of Rdg + Counts)**

Range	24 Hours 23°C ±1°C	Long Term 18°C-28°C		Plus Temp Coefficient Per °C*
		Up to 90 Days	>90 Day, Add to % of Rdg Per Month	
10Ω	0.003+20	0.005+20	0.00056	0.0008+15
100Ω	0.002+1.4	0.003+1.4	0.00033	0.0007+0.2
1 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.2
10 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.2
100 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.5
1 MΩ	0.002+0.8	0.003+0.8	0.00033	0.001+0.5
10 MΩ	0.0075+0.8	0.02+0.8	0.0022	0.005+0.5
100 MΩ	0.026+0.8	0.05+1	0.0056	0.02+0.5

*From 18°C to 0°C or 28°C to 50°C

**For 6½ digit display, multiply number of counts by 10

Measurement Configuration: Two-wire and four-wire available on all ranges

Four-Wire Lead Resistance: Source leads should not exceed 10Ω for the 10Ω and 100Ω ranges, 100Ω for the 1 kΩ range, or 1 kΩ for the 10 kΩ or higher ranges

DC Current Option (-03)

All current accuracy and stability specifications apply after a 2-hour warm-up. The 24-hour specifications are relative to the calibration standards used. No ac current option is available for the 8506A.

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Voltage Burden
		6½* Digits	5½ Digits	
100 μA	250.0000 μA	0.1 nA	1 nA	≤100 mV
1 mA	2.00000 mA	1 nA	10 nA	≤100 mV
10 mA	16.0000 mA	10 nA	100 nA	≤200 mV
100 mA	128.000 mA	100 nA	1 μA	≤200 mV
1A	1.28000A	1 μA	10 μA	≤500 mV

*In AVG operating mode 100 μA ac range is 5½ digits only

Accuracy, 5½ Digits: ±(% of Rdg + Counts)**

Range	24 Hours 23°C ±1°C	Long Term 18°C-28°C		Plus Temp Coefficient Per °C*
		Up to 90 Days	>90 Day, Add to % of Rdg Per Month	
100 μA	0.02+10	0.03+10	0.0022	0.0025+0.6
1 mA	0.02+10	0.03+10	0 0022	0.0025+0.6
10 mA	0.02+10	0.03+10	0 0022	0.0025+0.6
100 mA	0.03+20	0.05+20	0.0056	0.0035+0.6
1A	0.03+20	0.05+20	0.0056	0.0035+0.6

*From 18°C to 0°C or 28°C to 50°C

**For 6½ digit display, multiply number of counts by 10

Overload: 1.5A maximum, ±140V dc or peak ac to 60 Hz, or 200V peak ac above 60 Hz on any range with no damage. Protected by a 1.5A fuse.

Settling and Digitizing Time: Same as for dc volts

IEEE-488 Interface Option (-05)

This interface incorporates the following subset of the IEEE Standard 488-1978; SH1, AH1, T5, L4, SR1, RL2, DC1, DT1, and E1. The interface allows full control of all instrument functions and the transfer of ASCII or binary data. In the binary mode the instrument is capable of 500 readings per second.

RS-232C Interface Option (-06)

This interface is a bit serial asynchronous interface providing either voltage or 20 mA current loop level signals. The interface allows selection of baud rate from 50 to 9600, either one or two stop bits, and odd or even parity. Up to 40 ASCII character readings per second are possible with Option -06. No handshakes are provided.

Bit-Parallel Interface Option (-07A)

Permits you to connect the instrument to DEC PDP11 minicomputer interfaces (DR11C and DRV11). The interface permits either 8- or 16-bit parallel ASCII transfers or 8- or 16-bit parallel binary transfers. In the binary mode the instrument is capable of up to 500 readings per second.

8505A Specifications

Technical Specifications

DC Voltage

Same specifications as for 8506A

Ratio (External DC Reference)

Same specifications as for 8506A for dc ratio. AC/AC ratio available upon special request.

8505A Option Specifications

True-RMS AC Voltage Option (-09A)

All true-rms ac voltage accuracy and stability specifications apply to readings between 0.1% of range to full scale after a 2-hour warm-up. Options -09A and -01 may not be installed at the same time.

Input Characteristics (-09A and -01)

Range	Full Scale 5½ Digits	Resolution		Input Impedance
		6½* Digits	5½ Digits	
1V	2.50000V	1 μV	10 μV	MΩ shunted by <100 pF
10V	20.0000V	10 μV	100 μV	
100V	160.000V	100 μV	1 mV	
1000V	1000.00V	1 mV	10 mV	

*In AVG operating mode

Accuracy: ±(% of Rdg + % of Full Scale)*

Frequency	90 Days, 19°C to 28°C		
	% of Input	+ % FS (AC)	+ % FS (AC + DC)
DC	0.1	–	0.03
10 Hz-20 Hz	1.0	0.04	0.06
20 Hz-50 Hz	0.5	0.012	0.03
50 Hz-10 kHz	0.1	0.012	0.03
10 kHz-30 kHz	0.2	0.04	0.06
30 kHz-50 kHz	0.3	0.1	0.12
50 kHz-100 kHz	1.0	0.3	0.3
100 kHz-300 kHz	2.0	0.5	0.5
300 kHz-1 MHz	3.3	1.8	1.8

*Slow filter must be used below 400 Hz. For inputs greater than 500V multiply the accuracy specification by: (2000 + reading) ÷ 2000.

Common Mode Rejection: >120 dB, dc to 60 Hz, with 100Ω unbalance in either lead

Crest Factor: >7 at full scale, increasing down scale by

$$7 \times \sqrt{V_{Range} \div V_{Reading}}$$

Voltage & Frequency Limits: $1x10^7$ volt-hertz product for the 1V and 10V ranges and $2x10^7$ for the 100V and 1000V ranges

Analog Settling Time: 100 ms with Fast filter and 500 ms with Slow filter to within 0.1% of a step change within a range

Digitizing Time: Same as for dc voltage. See 8506A specifications.

8505A & 8506A

Averaging-Sensing AC Voltage Option (-01)

All average-sensing ac voltage accuracy and stability specifications apply to a 5½ digit display with readings between 0.1% of range to full scale after a 2-hour warm-up. Option -01 and -09A may not be installed at the same time. (See Input Characteristics -09A.)

Accuracy: ±(% of Rdg + Counts)*

Frequency	90 Days, 18°C to 28°C	
	1 mV to 500V**	Above 500V
30 to 50 Hz	0.5 + 5	0.55 + 5
50 Hz to 10 kHz	0.05 + 5	0.1 + 5
10 to 40 kHz	–	0.15 + 5
10 to 50 kHz**	0.1 + 5	–
50 to 100 kHz**	0.5 + 5	–

**Slow filter must be used below 400 Hz. For 6½ digit display, multiply number of counts by 10.*
***On 1-volt range add 7 counts above 10 kHz or 35 counts above 50 kHz*

Common Mode Rejection: >120 dB, dc to 60 Hz with 100Ω inbalance in either lead
Voltage & Frequency Limits: 1000V rms (1400V peak) or 2×10^7 volt-hertz product, whichever is less
Analog Settling Time: 100 ms with Fast filter and 500 ms with Slow filter to within 0.05% of a step change within a range
Digitizing Time: Same as for dc voltage. See 8506A specifications.

DC and AC Current Option (-03)

All accuracy and stability specifications apply after a 2-hour warm-up
Input Characteristics: Same as for 8506A
DC Current Accuracy: Same as for 8506A

AC Current Accuracy, 8505A only: ±(% of Rdg + Counts)*

Range	Frequency	90 Days, 23°C ±5°C	
		Opt -01	Opt -09A
100 µA	10 Hz - 20 Hz	–	1.0 + 110
	20 Hz - 50 Hz	0.8 + 9	0.8 + 35
	50 Hz - 10 kHz	0.4 + 9	0.4 + 35
	10 kHz - 20 kHz	0.7 + 9	1.0 + 110
	20 kHz - 50 kHz	1.5 + 9	1.5 + 260
	50 kHz - 100 kHz	3.0 + 9	4.0 + 760
1 mA and 10 mA	10 Hz - 20 Hz	–	1.0 + 110
	20 Hz - 50 Hz	0.5 + 9	0.5 + 35
	50 Hz - 10 kHz	0.06 + 9	0.11 + 35
	10 kHz - 20 kHz	0.11 + 9	0.2 + 110
	20 kHz - 50 kHz	0.12 + 9	0.3 + 260
	50 kHz - 100 kHz	0.51 + 9	1.0 + 760
100 mA	10 Hz - 20 Hz	–	1.0 + 150
	20 Hz - 50 Hz	0.5 + 55	0.5 + 80
	50 Hz - 10 kHz	–	0.26 + 80
	50 Hz - 100 kHz	0.24 + 55	–
1A	10 Hz - 20 Hz	–	1.0 + 160
	20 Hz - 50 kHz	0.5 + 65	0.5 + 90
	50 Hz - 10 kHz	0.24 + 65	0.26 + 90

**With 5½ digit display. For 6½ digit display, multiply number of counts by 10. AC Voltage Option -01 or -09A must also be installed to measure ac current.*

Crest Factor: (Using Option -09A) >4.5 at full scale, increasing down scale by

$$4.5 \times \sqrt{I_{Range} - I_{Reading}}$$

Maximum Overload: 1.5A maximum, ±140V dc or peak ac to 60 Hz, or 200V peak ac above 60 Hz on any range with no damage. Protected by a 1.5 fuse.
Settling and Digitizing Time: Same as dc volts

Resistance Option (-02B)

IEEE-488 Interface Option (-05)

RS-232C Interface Option (-06)

Bit-Parallel Interface Option (-07A)

Same specifications as for 8506A

General Specifications

Maximum Terminal Voltage:
LO to Guard, 127V rms
Guard to Chassis, 500V rms
HI Sense to HI Source, 127V rms
LO Sense to LO Source, 127V rms
HI Sense to LO Source, 1000V rms or 1200V dc
HI Source to LO Source, 280V rms

Trigger Input: TTL level, ±30V maximum, factory wired for falling edge; may be rewired for rising edge. Pulse width ≥10 µs.
Scanner Advance Pulse: TTL level, ≥3 µs width
Shock & Vibration: Meets requirements of MIL-T-28800C for Type III, Class 5, Style E equipment
Temperature: 0°C to 50°C, operating; -40°C to 70°C, non-operating
Relative Humidity: ≤80% to 18°C, ≤75% to 40°C, ≤45% to 50°C
Safety: Designed to comply with UL 1244, ANSI C39.5, IEC 348, and CSA Bulletin 556B. Factory Mutual (FM) approved. CSA Certified.
Power: 100, 120, 220 or 240V, 47-63 Hz, switch selectable
Size: 10.8 cm H x 43.2 cm W x 42.5 cm D (4.25 in H x 17 in W x 16.75 in D)
Weight: 10 kg (22 lb) basic, 12 kg (26 lb) fully loaded

Ordering Information

Models

8506A Thermal RMS Digital Multimeter
8505A Digital Multimeter

Included with Instrument
One-year product warranty, line cord, connector set, Getting Started manual, Instruction manual, Reference Guide, and Certificate of Calibration Practices.

Options
-02B* Ohms Converter
-03*¹ Current Converter
-05*** IEEE-488 Interface
-06*** RS-232C Interface

** Cannot install both -02B and -03 in 8506A at the same time*
¹ Provides only dc current when installed in 8506A
****Only one interface may be installed*

Options (for 8505A only)
-01* AC Converter (Average)
-09A* AC Converter (True-RMS)

**Cannot install both -01 and -09A at the same time*

Accessories (Also see Section 7)
MIS-7011K Extender Card
MIS-7013K Bus Interconnect & Monitor
MIS-7190K Static Test Controller
M04-205-600 5½" Rack Mount Kit
M00-260-610* 18" Rack Slide Kit
M00-270-610* 20" Rack Slide Kit
M00-280-610* 24" Rack Slide Kit
Y8021 IEEE-488 Shielded Cable, 1m
Y8022 IEEE-488 Shielded Cable, 2m
Y8023 IEEE-488 Shielded Cable, 4m
Y8133 Universal Test Leads

**Needs M04-205-600 Rack Mount Kit*

Manuals
8505A Getting Started*
8505A Instruction*
8506A Instruction*
8505/06A Reference Guide*
8505/06A-02A Instruction*
8505/06A-05 Insruction*
8505/06A-06 Instruction*
8505/06A-07 Instruction*

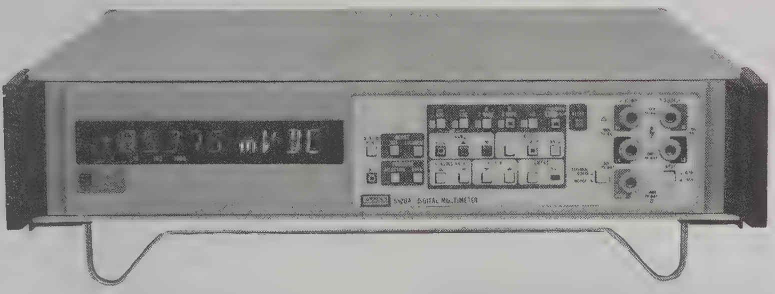
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

8520A, 8522A, 8520A/AS-1 & 8520A/PRT



(NSN 6625-01-123-0028) **8520A**

Intelligent DMMs for Bench or System

- DC and ac volts
- Two- and four-wire ohms
- Conductance
- 520 readings per second
- 20 ppm basic dc accuracy
- Burst memory and math capabilities
- Standard system interfaces: 8520A GPIB/IEEE-488; 8522A: Parallel and BCD
- 8520A/AS-1 MATE certified DMM

The 8520A and 8522A are designed for system and bench applications and have built-in system interface circuits. The performance specifications of the two instruments are almost identical. The principal difference is that the 8520A has an interface compatible with GPIB/IEEE-488* 1978 and the 8522A has an interface suitable for either BCD or Parallel (binary) applications.

The 8520A/AS-1 and the 8520A/PRT are unique variations of the 8520A. One, the 8520A/AS-1, is compatible with U.S. Government Modular Automatic Test Equipment (MATE) system. And the 8520A/PRT includes a Platinum Resistance Probe for extremely accurate temperature measurements.

Seven standard and seven optional math programs plus a built-in "burst" memory make these multimeters exceptionally intelligent stand-alone units. A choice of dc volts, true-rms ac volts, 2-wire or 4-wire ohms, and the Fluke exclusive conductance function make the instruments very versatile. The conductance function provides a simple way to measure resistance from 10 MΩ to 100,000 MΩ.

The instruments boast 50 ppm basic dc accuracy for 90 days with $5\frac{1}{2}$ digit resolution. A 520 readings-per-second system rate with $4\frac{1}{2}$ digits resolution is standard for high speed measurements. Or make 240 readings per second (with 60 Hz line operation) with $5\frac{1}{2}$ digits resolution. Inputs are switchable from front to rear too.

An unprecedented degree of prompting and operational cues are provided for skilled and unskilled technicians alike. A simple, uncluttered color-coded front panel makes operation easy.

Math Programs

Fourteen pre-programmed functions are available for the 8520A, 8522A, 8520A/AS-1 and 8520A/PRT. The first seven are standard; eight through fourteen are standard on the 8522A and 8520A/AS-1 but optional on the other models. For systems use, these powerful programs will reduce software overhead greatly. They also simplify and speed testing for ordinary bench applications. Up to three math programs can be chained or stacked for simultaneous use.

The Standard Programs

1 = TEST. Four separate internal test programs do diagnostic checks on analog circuitry, digital hardware and software, front panel keys and displays.

2 = ZERO. Eliminates the effect of lead resistance for ohms tests and subtracts low-level dc components in the dc voltage function.

3 = XREF (external reference). Compares an unknown voltage at the front panel to a known rear-panel input. The display is the ratio of the front and rear inputs.

4 = OSR (offset/scale/ratio). Allows you to enter any constant in the formula (X = measurement *minus* offset *times* scale *divided* by ratio) from the keyboard, the memory, or a current reading.

5 = Δ PCT (percent deviation). Compares all subsequent readings with a stored nominal value. The display appears as plus or minus a percentage deviation.

6 = PEAK. Constantly monitors the maximum and minimum readings. These values can be recalled as well as the "peak-to-peak" variation.

7 = LIM (limits). Turns the multimeter into a sorting machine. Inputs are sorted and displayed in three ways "High," "Pass" and "Low," based on previously stored upper and lower limits. You can recall the number of high, low, and pass readings, plus the total number of readings.

The Other Programs (Part of Option -010)

8 = STAT (statistics). Computes the mean, standard deviation, and variance of readings taken or data stored in memory registers.

9 = LFAC. A unique way to accurately measure low frequency ac signals from dc to 10 hertz.

10 = dB. Calculates dB, dBm or dBV of a measured value and displays dB.

11 = RTD. Implements equations which convert the resistance of a resistance temperature detector (RTD) to temperature in °C. Readouts in K or °F are also selectable.

12 = JVC (junction voltage Celsius). Computes °C, °F, or K based on inputs from a Fluke 80T-150C Temperature Probe (calibrated for °C).

13 = JVF (junction voltage Fahrenheit). For use with the Fluke 80T-150F (calibrated for °F). Performs the same operations as Program 12.

14 = THMS (thermistor linearization). Converts the resistance of a thermistor to temperature in °C, °F, or K.

Burst Memory (Reading Storage)

The unique burst memory lets you store up to 50 readings at any reading rate (400 readings with Option -010). In fact, the most recent 50 (or 400) readings are always stored in a shift register and available for recall and analysis whenever measurements cease. In the burst mode the storage operation may be independently triggered to capture a particular group of successive readings that may occur before, after, or both before and after the trigger instant. The storage of readings may be delayed after the trigger, as shown in example D.

Stored readings can be recalled individually or scanned in sequence for display on the front panel. Or they may be transferred to a controller or computer via the interfaces available in the 8520A or 8522A. Math processing can be applied to readings stored in memory as they are recalled.

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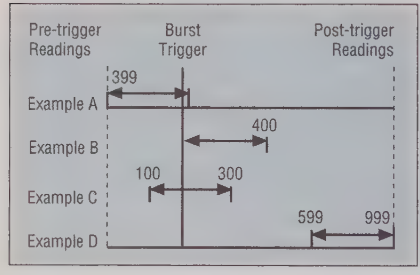
* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

8520A, 8522A, 8520A/AS-1 & 8520A/PRT

Burst memory, (400 readings part of Option -010)



With Option -010, the burst memory may capture any group of 400 successive readings that occur within 399 readings prior to and 999 readings following the burst trigger. In example A, only one reading is taken after the trigger point. In example B, 400 readings immediately following the burst trigger are captured. Example C shows storage of 100 readings prior and 300 readings after the trigger point. The last example shows 400 readings being stored commencing 599 readings after the trigger.

8522A Parallel and BCD Interface

Speed and real-time measurement are key system elements available in the 8522A when the Parallel (binary) interface is selected. That interface offers both a three- and a four-wire handshake (switch-selectable) for use with the most popular parallel computer interfaces. A choice of *eight*- or *sixteen*-bit messages are selectable at the rear of the instrument.

The BCD interface closely emulates BCD remote operation of the Fluke 8375A and 8400A, for the convenience of customers who wish to replace these or any of a large variety of older DMMs in their system. Remote control and data output capabilities are the same as those of the 8375A and 8400A. All but the conductance function may be controlled remotely, plus the range filter and external reference.

Output of readings include five BCD digits, an overrange bit, an overload bit, polarity bit, and three coded range bits. Status output includes function, filter, external reference and remote/local.

8520A/AS-1 – for MATE Systems

The 8520A/AS-1 is equipped with a built-in interface interpreter which makes it compatible with Modular Automatic Test Equipment (MATE) systems. This capability allows a MATE Test Executive to operate the 8520A/AS-1 on the IEEE-488 bus using Control Interface Intermediate Logic (CIIL). It will operate in either the "CIIL Mode," responding only to CIIL commands or in the "native mode," responding to either CIIL commands or IEEE-488 bus commands. Data transmission is increased to 120,000 characters per second for direct memory access using the CIIL mode.

The 8520A/AS-1 was the first candidate module to become MATE-certified.

8520A/PRT – Temperature Measurements

The 8520A/PRT is a temperature measurement system consisting of a Rosemount 162P Platinum Resistance Thermometer (PRT) and an 8520A containing a built-in linearization program customized to match the calibration curve of the specific PRT supplied. Temperature is indicated directly in either °C, °F or K with 0.001 degree resolution.

Specifications

Technical Specifications

DC Voltage

Range	Full Scale	Resolution	Input Resistance
100 mV	199.999	1 µV	≥10,000 MΩ
1V	1.99999	10 µV	≥10,000 MΩ
10V	16.0100	100 µV	≥10,000 MΩ
100V	130.100	1 mV	10 MΩ
1000V	1024.00	10 mV	10 MΩ

Accuracy: ±(% of Input + Digits)

Range	24 Hours 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient per °C*
100 mV	0.003+5	0.0065+6	0.011+10	0.0005+0.5
1V	0.003+1	0.006+2	0.011+2	0.0005+0.15
10V	0.002+1	0.005+1	0.009+1	0.0004+0.10
100V	0.003+1	0.007+2	0.012+2	0.0005+0.15
1000V	0.0035+1	0.0065+1	0.011+1	0.0005+0.10

**From 18°C to 0°C or 28°C to 50°C*

High Speed Accuracy: ±(% of Input + LS Bit)*

Range	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient Per °C
100 mV	0.01 + 1	0.015 + 1	0.001 + 0.1
1V-1000V			0.001 + 0.05

**Typical with 60 Hz line, remote operation, 500 readings per second, 2-byte binary output with 14 bits of data*

Normal Mode Rejection

Line Freq	Filter Setting Time					
	25 ms	50 ms	100 ms	200 ms	500 ms	1s
50 Hz	65 dB	68 dB	71 dB	80 dB	83 dB	86 dB
60 Hz	65 dB	68 dB	71 dB	85 dB	88 dB	91 dB

Common Mode Rejection: True, 100 dB at 50 Hz and 60 Hz with 1 kΩ unbalance in either lead. Effective CMR is equal to normal mode rejection plus true CMR.

Maximum Input: ±1000V peak, High to Low or Guard to chassis terminals, and ±200V peak, Guard to Low terminals, for any range
Bias Current: ≤50 pA

Maximum Reading Rate

Operation	Line	Rate	Resolution
Local	50 Hz	200 rdgs/sec*	5½ digits
Remote	60 Hz	240 rdgs/sec*	
Remote	50 Hz 60 Hz	>500 rdgs/sec	4½ digits

**For local operation, 8522A is limited to ½ this rate*

AC Voltage (True-RMS)

Input Characteristics

Range	Full Scale	Resolution	Input Resistance
1V	1.99999	10 µV	1 MΩ ≤100 pF
10V	16.0100	100 µV	
100V	130.100	1 mV	
650V	650.00	10 mV	

Accuracy: ±(% Input + % of Full Scale) ac or ac+dc*

Frequency	90 Days 18°C to 28°C			1 Year 18°C to 28°C		
	% of Input	+% FS AC	+% FS AC+DC	% of of Input	+% FS AC	+% FS AC+DC
10-20 Hz**	3.0	0.6	0.7	3.5	0.6	0.7
20-40 Hz**	0.5	0.5	0.6	0.6	0.6	0.7
40 Hz-20 kHz	0.1	0.03	0.08	0.15	0.05	0.16
20-100 kHz	1.0	0.3	0.4	2.0	0.6	0.8
100-300 kHz	2.4	0.6	0.6	4.0	0.1	0.1
300 kHz-1 MHz	8.0	2.5	2.5	15.0	5.0	5.0

**From 0.1% of range to full scale*
***With statistics program*

Temperature Coefficient: 18°C to 0°C or 28°C to 50°C, to 20 kHz
AC Mode: ±(0.007% of input + 0.007% FS)/°C
AC+DC Mode: ±(0.007% of input + 0.14% FS)/°C
Maximum Input: ±1000V peak High to Low or Guard to Chassic terminals, and ±200V peak Guard to Low terminals
Crest Factor: ≥4:1 at full scale, increasing down scale
Maximum Reading Rate: 10 readings per second (rated accuracy, ≥400 Hz)
Maximum Slew Rate: 177V per µs
Maximum Volt-Hertz Product: 2 x 10^7

8520A, 8522A, 8520A/AS-1 & 8520A/PRT

Resistance

Input Characteristics

Range	Full Scale	Resolution	Current Through Unknown	Open Circuit Voltage
10Ω	19.9999	100 µΩ	10 mA	7V
100Ω	199.999	1 mΩ	10 mA	
1000Ω	1999.99	10 mΩ	1.0 mA	
10 kΩ	19.9999	100 mΩ	0.1 mA	
100 kΩ	199.999	1Ω	14.5 µA (max)	
1 MΩ	1.99999	10Ω	1.5 µA (max)	
10 MΩ	19.999	1 kΩ	1.5 µA (max)	

Maximum Reading Rate

Operation	Line	Rate	Resolution
Local Remote	50 Hz	200 rdgs/sec*	5$^{1}/_{2}$ digits
	60 Hz	240 rdgs/sec*	
Remote	50 Hz 60 Hz	>500 rdgs/sec	4$^{1}/_{2}$ digits

**For local operation, 8522A is limited to $^{1}/_{2}$ this rate*

Accuracy: ±(% of Input + Digits)

Range	24 Hrs 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient Per °C*
10Ω	0.0045+6	0.0080+7	0.0140+12	0.0007+2.0
100Ω	0.0035+2	0.0070+2	0.0125+3	0.0007+0.2
1000Ω	0.0035+2	0.0070+2	0.0125+3	0.0007+0.2
10 kΩ	0.0035+2	0.0070+2	0.0125+3	0.0007+0.2
100 kΩ	0.0040+2	0.0090+2	0.0140+3	0.0012+0.2
1 MΩ	0.0090+2	0.0160+2	0.0200+3	0.0020+0.2
10 MΩ	0.0300+1	0.0440+1	0.0450+3	0.0030+0.2

**From 18°C to 0°C or 28°C to 50°C*

Conductance

Range: 100 nS (10 MΩ)$^{-1}$
Full Scale: 199.99
Resolution: 0.01 nS (100,000 MΩ)$^{-1}$

Accuracy: ±(% of Input + Digits)

24 Hours 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient Per °C*
0.4+5	0.05+5	0.06+5	0.004+1

**From 18°C to 0°C or 28°C to 50°C*

Maximum Input: ±400V peak
Maximum Reading Rate: 10 readings per second

External Reference

Operating Range: ±0.5V dc to ±33V dc as long as external reference Low terminal is within ±16.5V of input Low terminal
Input Impedance: 10,000 MΩ between external reference High or Low terminals and input Low terminal

Ratio Accuracy

X-Ref Voltage	Accuracy
16.5V to 33V	±(A + B + 20 ppm)
0.5V to 16.5V	±[A + B + (400 ppm ÷ I Vref I)]

Note: A = DC 10 volt range accuracy
B = Input voltage or resistance range accuracy

Maximum Input: ±180V peak between external reference High or Low and input Low; ±360V peak between external reference High and Low

General Specifications

IEEE-488 Interface: Standard in the 8520A, 8520A/AS-1 and 8520A/PRT
Parallel (Binary) and BCD Interface: Standard in 8522A
BCD Data Output: Standard 0V and +5V TTL levels positive true, 8-4-2-1 code. Five BCD digits with an overrange bit, overload, polarity, and three coded range bits. The output also includes the state of the instrument (function, filter, external reference, and remote or local).
BCD Remote Control: Standard TTL levels – Logic 1 equals +5V or open, Logic 0 equals 0V or contact closure. Controls all functions (except conductance), range, filter (fast, slow), and external reference. Continuous-command entry and triggered-command entry.
Parallel: In bit parallel operation all features and functions can be accessed through the remote interface. Maximum speed in this mode is 520 readings per second.
Format: Select 8- or 16-bit message format with a rear panel switch
Handshake: Handshake configuration is also switch selectable 3- or 4-wire for compatibility with computers, mini-computers, and instrument controllers
Temperature: 0°C to 50°C, operating; -25°C to +75°C non-operating; for 8520A/AS-1, non-operating temperature range is -40°C to +75°C
Altitude: 10,000 feet operating, 40,000 feet non-operating
Relative Humidity: ≤95% to 25°C, ≤75% to 40°C, ≤40% to 50°C
Shock & Vibration: Meets MIL-T-28800C for Type III, Class 5, Style E
Safety: Designed to comply with UL 1244, ANSI C39.5, IEC 348, and CSA Bulletin 556B. Factory Mutual (FM) approved. CSA Certified.
Power: 100, 120, 220, or 240V ac, ±10%, 50 to 60 Hz, ≤50W
Size: 8.9 cm H x 45.7 cm L x 43.2 cm W (31/2 in H x 18 in L x 17 in W)
Weight: 9.56 kg (21 lb)

Ordering Information

Models

8520A DMM w/IEEE-488 Interface
8522A DMM w/BCD & Parallel Interface
8520A/AS-1 DMM for MATE
8520A/PRT Temperature Meas. System

Included with Instrument
One-year product warranty, line cord, operator manual, rear panel mating connector for analog input, quick reference guide, operator, service, and calibration manuals, and Certificate of Calibration Practices.

Option (for 8520A & 8520A/PRT)
-010 Extended Software Package*

**Included with 8520A/AS-1 and 8522A. Factory or Service Center installation only.*

Accessories (Also see Section 7)
Y9112 Trigger Cable, 1.85m (6 ft)
Y8133 Universal Test Lead Set
Y2037 100Ω RTD Temperature Probe
Y8021 IEEE-488 Shielded Cable, 1m
Y8022 IEEE-488 Shielded Cable, 2m
Y8023 IEEE-488 Shielded Cable, 4m
Y8597 Interface Adapter for 8375A, 8400A
Y8598 3$^{1}/_{2}$" Rack Mount Kit w/22" slides
Y8599 3$^{1}/_{2}$" Rack Mount Kit only

Manuals
8520A Rack Mtg
8520A Calibration*
8520A Getting Started*
8520A Operator*
8520A Service
8520A/AS Addendum*
8520A/AS Quick Ref. Guide*
8520A/AS-1 Quick Ref. Guide*
8520A/AS-1 Addendum*
8520A/PRT Addendum*
8522A Calibration*
8522A Operator*
8522A Service

** No charge with purchase of unit*

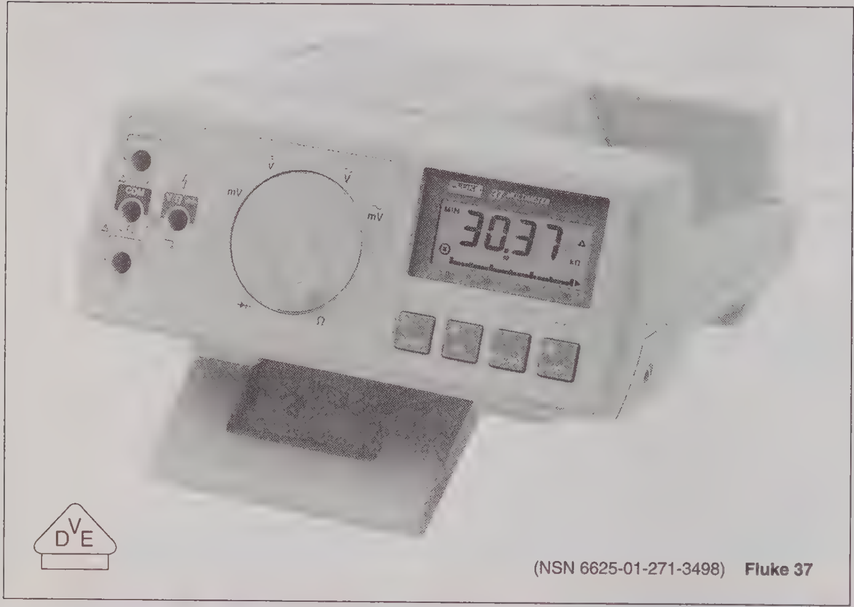
Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

37

Available through Distributors



(NSN 6625-01-271-3498) **Fluke 37**

Fluke 37 Bench Portable Digital Multimeter
Sloped front panel for easy viewing
3200-count digital display, combined with fast 31-segment analog bar graph
Min/Max and Relative modes
Fast autoranging and Touch Hold® functions
0.1% basic dc accuracy, overload protection to 1000V rms, fused 10A range
Built-in storage compartment for accessories and a detachable tilt stand
Superior shielding against electromagnetic interference (EMI)
Survives 6 kV transients on 660V major ac feeders
Designed to meet UL 1244 requirements

Unique Case Design

The internal design of the Fluke 37 allows the front panel to slope 15 degrees, permitting easy viewing from a number of operating positions. When used in the flat position the Fluke 37 may be stacked with other instruments.

Storage Compartment/Carrying Handle

A storage compartment for test leads and small accessories is built into the case. Access to the battery and fuses is through a snap-out door inside this compartment. A built-in carrying handle (molded into the case) offers portability when needed.

High Performance

0.1% basic dc accuracy, low millivolt to 1000V ac and dc voltage measurements, 30 kHz ac response, low microamp to 10A ac and dc current measurements, low milliohms to 32 MΩ resistance, up to 10,000 MΩ with conductance.

3200-Count Digital Display

Better accuracy and resolution than a conventional $3^1/_2$ digit (2000 count) DMM, high contrast liquid crystal display with a wide viewing angle, updated two times per second.

31-Segment Analog Bar Graph

Makes dynamic indications such as peaking, nulling, zero adjustments and capacitor checking. Updates ten times faster than digital readout.

Min/Max & Relative Modes

Min/Max stores the highest and lowest digital reading, allowing a signal to be monitored for seconds, or days. The Relative mode remembers a reading and shows the change (difference) between it and any following readings.

Fast Autoranging

Simplifies and speeds up the use of the meter by instantly selecting the proper range. Selectable manual ranging included.

Touch Hold

The meter will beep, capture a measurement, and lock it on the digital display until you're ready to view it. Automatically updates with each new stable measurement if preferred for later viewing.

Audible Continuity/Diode Test

Wiring, diode and transistor checks can be done quickly without looking at the display. Easy to hear, mid-frequency beeper (1500 Hz).

EMI Shielding

A unique conductive shield fully encloses all circuitry to provide exceptional protection against electromagnetic interference.

Safety Designed

Extensive overload protection, high energy fuses, fused 10A range, non-metallic case and tilt-stand. All voltage inputs meet the power line surge tests for major feeders as defined in IEEE-587-1980, Category B, which includes simulated lightning and load switching transient pulses up to 6 kV superimposed on 660V power lines.

Power

The Fluke 37 is battery powered for true portability. It is also equipped with an input jack which accepts the optional Fluke A81 battery eliminator accessory for continuous operation from line voltage. Typical battery life 1000 hours.

Standard Equipment

Every meter is packaged with a pair of safety-designed TL70A right-angle test leads, spare fuse, 9 volt battery, and operator's manual.

Specifications

Technical Specifications

Basic electrical specifications are defined for the temperature range of 18° C to 28° C for one year after calibration. Accuracy is specified as within ±(% of reading plus number of least significant digits).

DC Voltage

Range	Resolution	Accuracy
320.0 mV	100 µV	0.1% + 1
3.200V	1 mV	
32.00V	10 mV	
320.0V	100 mV	
1000V	1V	

Input Impedance: 10 MΩ nominal
Normal Mode Rejection Ratio: >60 dB at 50 and 60 Hz
Common Mode Rejection Ratio: >120 dB at dc, 50 Hz and 60 Hz; ≤1 kΩ unbalance
Overload Protection: 1000V rms; 500V rms on 320 mV range
Response Time: ≤2s to rated accuracy

AC Voltage

Range	Resolution	Accuracy		
		40 Hz-2 kHz	2 kHz-10 kHz	10 kHz - 30 kHz
320.0 mV	100 µV	0.5% + 3	2% + 3	4% + 10
3.200V	1 mV			
32.00V	10 mV			
320.00V	100 mV			
1000V	1V	1% + 3	3% + 3	Not Spec

Extended Frequency Response: Typical -3 dB @ 100 kHz
Conversion Type: AC coupled, average sensing, calibrated to read the rms value of a sinewave
Input Impedance: 10 MΩ nominal, <100 pF
Common Mode Rejection Ratio: >60 dB, dc to 60 Hz, ≤1 kΩ unbalance
Overload Protection: 10^7 volt-hertz maximum, 1000V, 500V on 320 mV range
Response Time: ≤2s to rated accuracy

DC & AC Current

Range	Resolution	Nominal Burden Voltage
320.0 µA	0.1 µA	0.5 mV/µA
3200 µA	1 µA	0.5 mV/µA
32.00 mA	10 µA	5.6 mV/mA
320.0 mA	100 µA	5.6 mV/mA
10.00A	10 mA	50 mV/A

DC Accuracy: Within 0.75% + 2
AC Accuracy: Within 1.5% + 2 (40 Hz to 1 kHz)

Overload Protection
10A Range: 15A/600 fuse, 100,000A interrupt rating
mA Range/µA Ranges: 630 mA/250V fuse, 1500A interrupt rating; in series with a 2A/600V fuse, 10,000A interrupt rating

Response Time: ≤2s to rated accuracy

Ohms

Range	Resolution	Accuracy
320.0	0.1Ω	0.3% + 2
3.200k	1Ω	0.2% + 1
32.00k	10Ω	
320.0k	100Ω	
3.200M	1 kΩ	
32.00M	10 kΩ	1% + 1
32.00 nS	0.01 nS	2% + 10

Overload Protection: 500V rms
Test Voltage: <420 mV dc full scale up to 3.2 MΩ; >1.3V up to 32 MΩ, <2.8V open circuit
Test Current: <1 mA
Response Time: ≤6s to rated accuracy in highest and lowest range; ≤2s for other ranges

Diode Test & Continuity

Diode Test Indication: Displays voltage drop; 0.5 mA nominal test current at 0.6V; 2.0V full scale. Momentary tone for test voltage dropping below 0.7V (typical silicon diode threshold).
Continuity Indication: Continuous audible tone for test resistance below approximately 150Ω
Open Circuit Test Voltage: <3.3V
Overload Protection: 500V rms

General Specifications

Storage Temperature: -55°C to 85°C
Operating Temperature: -15°C to 55°. Operate to -40°C for 20 minutes when taken from a 20°C environment 0°C to 50°C.
Temperature Coefficient: 0.1 x the applicable accuracy specification per °C (<18°C or >28°C)
Relative Humidity: ≤90% (≤80% in 32 MΩ range) to 35°C, ≤70% to 50°C
Shock & Vibration: Per MIL-T-28800, Class 3
Electro-Magnetic Interference (EMI): MIL-STD-461 for RS03 (radiated susceptibility to 1V/meter from 14 kHz to 1 GHz) and RE02 (radiated emissions)
MIN/MAX Mode: Records digital display readings, updated twice per second
Digital Display: 3200 counts plus polarity indication, updated 2 times per second
Analog Display: 31 segment bar graph plus polarity indication, updated 25 times per second
Maximum Voltage to be Applied to any Terminal: 1000V with respect to earth ground
Battery: 9V NEDA 1604. Symbol when 60 hours remain. 1000 hour typical.
Safety: Protection Class II per IEC 348 and ANSI C39.5, CSA C22.2 No. 231, and UL 1244
Size: 97 mm H x 216 mm W x 231 mm L (3.8 in H x 8.5 in W x 9.1 in L)
Weight: 1.31 kg (2.9 lb)

Ordering Information

Model

Fluke 37 Multimeter

Included with Instrument
One-year product warranty, TL70A test leads, spare fuse, battery and Operator manual.

Accessories (Also see Section 7)

TL20	Industrial Test Lead Set
Y8134	Universal Test Lead Set
Y8140	Needle Point Test Lead Set
A81	Battery Eliminator
83RF	High Frequency Probe, 100 MHz
85RF	High Frequency Probe, 500 MHz
80TK	Thermocouple Module
80T-150U	Universal Temperature Probe
80K-6	High Voltage Probe
80K-40	High Voltage Probe
Y8100	Clamp-on DC/AC Current Probe
Y8101	Clamp-on AC Current Probe
80i-400	Clamp-on AC Current Probe
80i-410	Clamp-on DC/AC Current Probe
80i-600	Clamp-on AC Current Probe
80i-1010	Clamp-on DC/AC Current Probe
80i-kW	Current/Power Probe

Manuals
Fluke 37 Operator*
Fluke 37 Service
**No charge with purchase of unit*

Customer Support Services

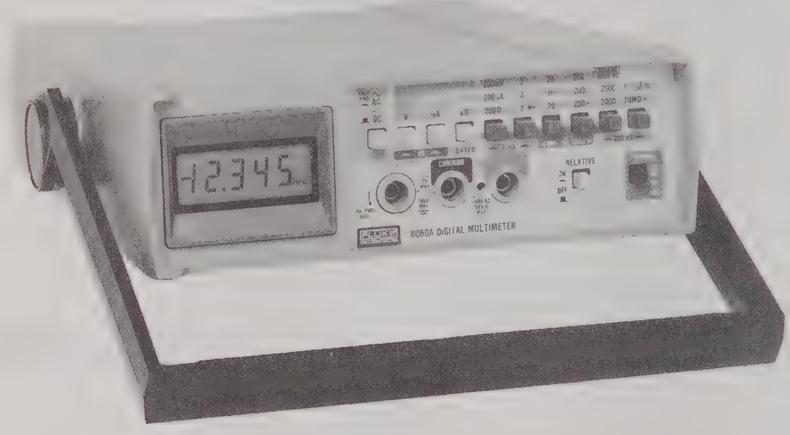
Also see Section 20.

Factory Warranty
One-year product warranty.

AVAILABLE THROUGH DISTRIBUTORS

8050A

Available through Distributors



(NSN 6625-01-115-2141) **8050A**

8050A Bench/Portable Digital Multimeter

- 4$^1/_2$ digits (20,000 counts)
- Nine functions including relative reference, dB, conductance, diode test
- 0.03% basic dc accuracy
- True-rms ac from 20 Hz to 50 kHz
- Microcomputer-based
- Extensive overload protection
- Rechargeable-battery version available (-01)
- Optional touch-hold probe (80T-H)
- Probes for rf, high voltage, high current available
- Factory Mutual approved

The 8050A provides superior performance and measurement capabilities in a low-cost, benchtop instrument. This 4$^1/_2$-digit DMM has the following measurement functions: dc volts, true-rms ac volts, dc amps, true-rms ac amps, ohms, dBm (with selectable reference impedances) conductance, and diode test. It also has a relative-reference feature that works with all measurement functions.

True-RMS AC

The 8050A uses a true-rms conversion technique to assure accurate measurement of non-sinusoidal waveforms as well as pure sinewaves. Examples: distorted or modulated sinewaves, squarewaves, sawtooths, noise, and pulse trains with a duty cycle of 10% or higher. Specified accuracy extends from 20 Hz to 50 kHz. Useful measurements go to 200 kHz, the typical -3 dB bandwidth.

dB Function

While many analog meters will indicate dBm referenced to 600 ohms, the 8050A provides digital read-out of decibels referenced to any one of sixteen impedances from 8 ohms to 1200 ohms. Now there is no need to use manual conversion tables – the internal microprocessor does the calculations for you. A front panel pushbutton and scrolling memory lets you select the reference impedance needed.

Relative Reference

When the RELATIVE switch is on, the displayed value is equal to the difference between the present input value and a previously stored reference value.

Specifications

Technical Specifications

All accuracy specifications apply for one year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of 90% or less.

DC Voltage*

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V
Resolution: 10 µV on lowest range, 0.1V on 1000V range
Accuracy: ±(0.03% of reading + 2 digits) all ranges
Input Impedance: 10 MΩ, ≤100 pF, all ranges
Normal Mode Noise Rejection: ≥60 dB at 50 Hz or 60 Hz
Common Mode Noise Rejection: ≥90 dB at dc, 50 Hz and 60 Hz with 1 kΩ unbalance
Overload Protection: 1000V dc or peak ac, continuous, except 10 seconds maximum on the 200 mV and 2V ranges
Response Time: 1 second maximum, to rated accuracy within a range

**DC voltage can also be measured using the dB mode with 0.01 dB resolution between 5% of range and full range*

AC Voltage (True-RMS, AC Coupled)

Voltage Readout: From 5% to 100% of range

Range	Resolution	Accuracy: ±(% of Rdg+Digits)					
		20 Hz*	45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
200 mV	10 µV	1% +10	0.5% +10		1% +10	5% +30	
2V	100 µV						
20V	1 mV						
200V	10 mV						
750V	100 mV		Not specified				

** Typically 3 to 5 digits of "rattle" will be observed at 20 Hz at full scale*

dB Readout: From 5% to 100% of range

Input Voltage	dBm 600Ω Ref	Range	Accuracy					
			20 Hz	45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
0.77mV -2mV	-60 to -52	200 mV*`	±0.5 dBm				N/S	
2mV -2V	-52 to +8							
0.1V -2V	-18 to +8	2V*	±0.25 dBm	±0.15 dBm		±0.25 dBm	±0.75 dBm	
1V-20V	+2 to +28	20V						
10V-200V	+22 to +48	200V						
100V-750V	+42 to +60	750V			Not specified (N/S)			

** When 200 mV range is selected, 8050A autoranges for best accuracy for inputs up to 2V*

8050A

dB Resolution: ±0.01 dB from 5% to 100% of range; 0.1 dB from 1% to 5% of range; 1.0 dB below 1% of range
Decibel Reference Impedances: Fifteen user-selectable impedance reference levels are provided to reference a 0 dBm, 1 mW level (50Ω, 75Ω, 93Ω, 110Ω, 125Ω, 135Ω, 150Ω, 250Ω, 300Ω, 500Ω, 600Ω, 800Ω, 900Ω, 1000Ω, 1200Ω. An 8Ω impedance reference level is provided to reference 0 dBW. (dBV = 1000Ω).
Input Impedance: 10 MΩ, ≤100 pF, all ranges
Extended dB Response: Typically -72 dBm (600Ω ref) ±1 dB to 10 kHz
Useful Frequency Range: Typically -3 dB at 200 kHz
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Common Mode Noise Rejection: 90 dB at 50 Hz and 60 Hz with 1 kΩ unbalance
Overload Protection: 750V rms or 1000V peak continuous, except 10 seconds maximum on the 200 mV and 2V ranges, not to exceed a volt-hertz product of 10^7 (e.g., 200V at 50 kHz)
Response Time: 2 seconds max to rated accuracy within a range

DC Current

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Burden Voltage
200 µA 2 mA 20 mA 200 mA	10 nA 100 nA 1 µA 10 µA	±(0.3% of rdg + 2 digits)	0.3V typ
2000 mA	100 µA		0.9V typ

Overload Protection: 2A/250V and 3A/600V fuses in series

AC Current (True-RMS, AC Coupled)

Range	Resolution	Accuracy: (5% to 100% of Range)*				
		20 Hz**	45 Hz	2 kHz	10 kHz	20 kHz
200 µA 2 mA 20 mA 200 mA	10 nA 100 nA 1 µA 10 µA	2% + 10		1% + 10	2% + 10	
2000 mA	100 µA				Not spec'd	

*Accuracy applies from 5% to 100% of range
**Typically 3 to 5 digits of "rattle" will be observed at 20 Hz at full range

Burden Voltage: 0.3V rms typ., 200 µA through 200 mA range; 0.9V typ. on 2000 mA range
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Overload Protection: 2A/250V and 3A/600V fuse in series

Resistance

Range	Resolution	Accuracy	Full Scale* Voltage
200Ω 2 kΩ*	0.01Ω 0.1Ω	±(0.1% reading +2 digits+0.02Ω)	0.19V 1.2V
20 kΩ 200 kΩ*	1Ω 10Ω	±(0.05% reading +2 digits)	0.2V 2V
2000 kΩ 20 MΩ*	199Ω 1 kΩ	±(0.25% reading +3 digits)	0.2V 2V

Diode test ranges

Diode Test: The three diode test ranges are marked with a diode symbol and have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with the larger diode symbol. The three non-diode test ranges will not turn on silicon junctions when making in-circuit resistance measurements.
Open Circuit Voltage: Less than 3.5V on all ranges
Input Protection: 500V dc or rms ac on all ranges
Response Time: (To rated accuracy) 10 seconds maximum on 20 MΩ range, 2 seconds maximum on all other ranges

Conductance

Range	Resolution	Accuracy
2 mS 200 nS	0.1 µS 0.01 nS	±(0.1% of reading + 5 digits) ±(0.5% of reading + 20 digits)

Equivalent Resistance
2 mS Range: 500Ω to 10 MΩ
200 nS Range: 5 MΩ to 100,000 MΩ
Open Circuit Voltage: Less than 3.5V on both ranges
Input Protection: 500V dc or rms ac on all ranges

Relative Reference

An input applied when the RELATIVE button is depressed is held as "0" reference point. Subsequent readings indicate deviations ± from this point.
Accuracy: Error will not exceed the sum of the errors for the two measurements

General Specifications

Common Mode Voltage: 500V dc or peak ac max
Temperature: 0°C to 50°C, operating; -40°C to +70°C non-operating, except -40°C to +50°C with batteries
Temperature Coefficient: ≤0.1 times the applicable accuracy specification per °C from 18°C to 0°C and from 28°C to 50°C
Relative Humidity: ≤70% to 50°C or ≤90% to 35°C, except 2000 kΩ, 20 MΩ, and 200 nS ranges where it is <80% to 35°C
Safety: IEC 348, Protection Class I when operated from supply mains or Protection Class II when operated from internal batteries. ANSI C39.5 Factory Mutual 3820 Approved. CSA 556B Certified.
Power: 90 to 110V ac, 105 or 132V ac, or 200 to 264V ac, 47 to 440 Hz, factory-configured for customer-specified voltage. With rechargeable battery version (-01), the line voltage range is field-changeable. 4W max, 6W with -01 version.
Batteries: NiCd batteries are installed in version -01. They provide 10 hours of typical operation on a full charge. Recharge takes 14 hours. Can run on ac line while charging.
Size: 22 cm W x 6 cm H x 25 cm L (8.5 in W x 2.5 in H x 10 in L)
Weight: 1.08 kg (2.38 lb) for standard model

Ordering Information

Models

8050A DMM
8050-01 DMM w/rechargeable batteries

Included with Instrument
One-year product warranty, line cord, Instruction manual, TL70A test leads, and Certificate of Calibration Practices.

Accessories (Also see Section 7)
M00-200-611, 3$^{1}/_{2}$" Rack Mount Kit, Offset
M00-200-612 3$^{1}/_{2}$" Rack Mount Kit, Center
M00-200-613 3$^{1}/_{2}$" Rack Mount Kit, Dual

Manual
8050A Instruction*
**No charge with purchase of unit*

Customer Support Services

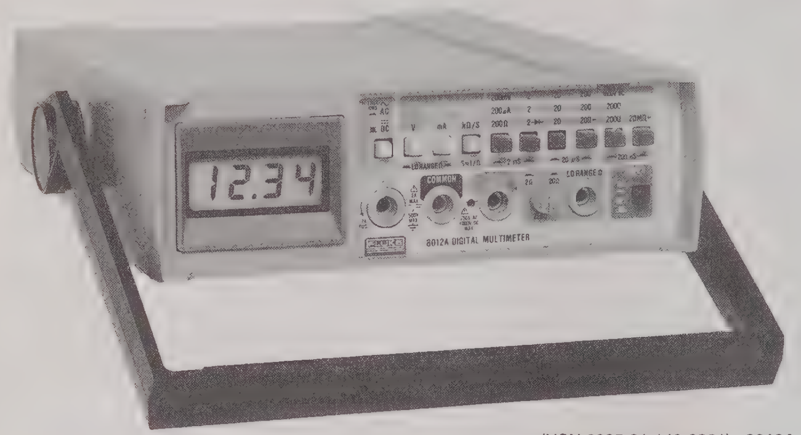
Also see Section 20.

Factory Warranty
One-year product warranty.

AVAILABLE THROUGH DISTRIBUTORS

8010A & 8012A

Available through Distributors



(NSN 6625-01-140-0221) **8012A**

8010A & 8012A, Bench/Portable Digital Multimeters

- 3½ digits (2000 counts)
- Seven functions including conductance, diode test
- 0.1% basic dc accuracy
- True-rms ac from 45 Hz to 50 kHz
- 10A range (8010A only); 2Ω and 20Ω range (8012A only)
- Optional touch-hold probe (80T-H)
- Extensive overload protection
- Rechargeable-battery version available (-01)
- Extended measurements with optional accessories
- Factory Mutual approved

The 8010A and 8012A are 3½ digit portable/bench DMMs, that offer exceptional performance and features at a low cost. Measurement functions include: dc volts, true-rms ac volts, dc amps, true-rms ac amps, ohms, conductance, and diode test. The difference is that only the 8012A features two low-resistance ranges (2 ohms and 20 ohms) and only the 8010A features a 10A current range. Rechargeable-battery versions are available as Models 8010A-01 and 8012A-01. The 8010A and 8012A operate on ac line power only.

True-RMS

A Fluke-manufactured true-rms converter assures accurate measurements of non-sinusoidal voltage or current waveforms such as squarewaves (crest factor of 1 to 1). This custom hybrid provides low noise and a wide bandwidth. Accuracy is specified to 50 kHz, but the typical -3 dB bandwidth is 200 kHz.

10A Range (8010A Only)

The 8010A has a 10 ampere ac or dc current range for applications that require measuring more than 2 amperes.

Low Ohms (8012A Only)

The 8012A has two additional ranges of low resistance - 2 ohms and 20 ohms. Along with the conductance function, that gives you a resistance range of 0.001Ω to 10,000 MΩ! There are not many resistance measurements that the 8012A can't handle.

Overload Protection

When measuring resistance or conductance, up to 500 volts may be applied with no instrument damage. Voltage inputs can handle 1000V dc or peak ac and transients up to 6 kV. The 2A current input is protected with two in-series fuses – 2A/250V and 3A/600V. In normal overload situations, only the common 2A/250V fuse will blow. The 3A/600V back-up fuse protects the DMM should the 2A/250V fuse ionize when accidentally attached to a source of more than 250 volts – like a 480-volt power line.

Extended Measurements

Optional accessories enable you to extend the measurement capabilities of the 8010A and 8012A. For example, measure current to 600A, rf voltage to 500 MHz, voltage to 40 kV, and temperature to 1000°C (1832°F).

Specifications

Technical Specifications

All accuracy specifications are for one year after purchase or recalibration when operated in a temperature range of 18°C to 28°C

DC Voltage

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V
Resolution: 100 µV on lowest range 1V on 1000V range
Accuracy: (±0.1% of reading + 1 digit) on all ranges
Input Impedance: 10 MΩ on all ranges
Normal Mode Noise Rejection: ≥60 dB at 50 Hz or 60 Hz
Commom Mode Noise Rejection: ≥90 dB at dc, 50 Hz and 60 Hz with 1 kΩ unbalance
Overload Protection: To 1000V dc or peak ac on any range
Response Time: 1 second maximum

AC Voltage (True-RMS, AC Coupled)

Range	Resolution	Accuracy: ±(% of Reading + Digits)*				
		45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
200 mV 2V 20V 200V	100 µV 1 mV 10 mV 100 mV	0.5% + 2			1.0% + 2	5% + 3
750V	1V	0.5% + 2	Not specified			

**Accuracy applies from 5% to 100% of range*

Useful Frequency Range: Typically ±3 dB at 200 kHz
Input Impedance: 10 MΩ in parallel with <100 pF
Commom Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz with 1 kΩ unbalance
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Overload Protection: To 750V rms, 1000V peak, not to exceed 10^7 volt-hertz product (10 seconds maximum on 200 mV and 2V ranges)
Response Time: 2 seconds maximum

8010A & 8012A

Resistance

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Full Scale Voltage	Max Test Current
2Ω	1 mΩ	1.0% + 2	0.02V	10 mA
20Ω	10 mΩ	0.5% + 2	0.2V	10 mA
Note...above ranges in 8012A only				
200Ω	0.1Ω	0.2% + 1	<0.25V	1.30 mA
2 kΩ*	1Ω		>1.0V	1.30 mA
20 kΩ	10Ω		<0.25V	10.0 µA
200 kΩ*	100Ω		<1.0V	35.0 µA
2000 kΩ	1 kΩ	0.5% + 1	<0.25V	0.10 µA
20 MΩ*	10 kΩ		>1.5V	0.35 µA

**Diode test ranges*

Diode Test: The three diode test ranges are marked with a diode symbol and have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with the larger diode symbol. The non-diode test ranges will not turn on silicon junctions when making in-circuit resistance measurements.

Open Circuit Voltage: <3.5V on all ranges except <16V on 2Ω and 20Ω ranges

Input Protection: To 300V dc or rms on 2Ω and 20Ω ranges. 500V dc on all other ranges

Response Time: 1 second on all ranges except 2000 kΩ and 20 MΩ where time is 4 seconds, maximum

Conductance

Conductance is the inverse of ohms (1/Ω) and is expressed in Siemans (S), formerly ohms

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Full Scale Voltage	Max Test Current
2 mS	1 µS	0.2% + 1	<3.5V	1.3 mA
20 µS	10 nS	0.2% + 1	<1.0V	10 µA
200 nS	0.1 nS	1.0% + 10	<1.0V	0.1 µA

Equivalent Resistance

2 mS Range: 500Ω to 1 MΩ
20 µS Range: 50 kΩ to 100 MΩ
200 nS Range: 5 MΩ to 10,000 MΩ

Input Protection: To 500V dc or rms on all ranges

DC Current

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Burden Voltage
200 µA 2 mA 20 mA 200 mA	0.1 µA 1 µA 10 µA 100 µA	0.3% + 1	0.3V typ
2000 mA	1 mA		0.9V typ
10A*	10 mA	0.5% + 1	0.5V typ

**This range in 8010A only*

Overload Protection: 2A, 250V front panel fuse in series with 3A/600V front panel fuse, 10 Ampere range in 8010A not fused, 12A maximum

Response Time: 1 second maximum

AC Current (True-RMS, AC Coupled)

Range	Accuracy: ±(% of Reading + Digits)*				Burden Voltage
	45 Hz	2 kHz	10 kHz	20 kHz	
200 µA 2 mA 20 mA 200 mA	1% + 2		2% + 2		0.3V typ
2000 mA 10A**	1% + 2	Not specified			0.9V typ 0.5V typ

**Applies from 5% to 100% of range*
***This range in 8010A only*

Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1

Response Time: 2 seconds maximum

Other Specifications: Same as for dc current

General Specifications

Display: $3^1/_2$ digit (2000 counts), LCD, autozero, autopolarity

Common Mode Voltage: 500V dc or peak ac, maximum

Touch and Hold: Holds a voltage or resistance reading when the mA jack is momentarily shorted to COMMON. Accessory probe 80T-H is recommended.

Temperature: 0°C to +50°C, operating; -40°C to +60°C non-operating, except -40°C to +50°C with batteries

Temperature Coefficient: <0.1 times the applicable accuracy specification per °C, from 18°C to 0°C and 28°C to 50°C

Relative Humidity: ≤70% to 50°C or ≤90% to 35°C except for 2000 kΩ, 20 MΩ, and 200 nS ranges where it is ≤80% to 35°C

Safety: IEC 348, Protection Class I when operated from supply mains or Protection Class II when operated from internal batteries. ANSI C39.5 Factory Mutual 3820 Approved. CSA 556B Certified.

Power: 90 to 132 ac or 200 to 264V ac, 50 or 60 Hz, 2W for standard models. With battery version (-01), voltage and frequency range is selectable with internal switches, 3.5W.

Batteries: Rechargeable NiCd batteries and recharge circuits installed in version -01. Recharge time approximately 14 hours. "BT" on display appears when approximately 1/2 hour of operation remains. Fifteen to thirty hours of operation typical of full charge, depending on functions used.

Size: 6 cm H x 22 cm W x 25 cm D (2.5 in H x 8.5 in W x 10 in D)

Weight: 1.08 kg (2.38 lb) for standard models, 1.42 kg (3.13 lb) for version -01 with batteries

Ordering Information

Models

8010A DMM w/10A Range
8010A-01 DMM w/Batteries
8012A DMM w/2Ω and 20Ω Range
8012A-01 DMM w/Batteries

Included with Instrument

One-year product warranty, line cord, Instruction manual, Y8131 test leads, and Certificate of Calibration Practices.

Accessories (Also see Section 7)

M00-200-611 $3^1/2$" Rack Mount Kit, Offset
M00-200-612 $3^1/2$" Rack Mount Kit, Center
M00-200-613 $3^1/2$" Rack Mount Kit, Dual

Manual

8010A/8012A Instruction*

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty

One-year product warranty.

AVAILABLE THROUGH DISTRIBUTORS

8920A, 8921A & 8922A

GPIB IEEE-488

(NSN 6625-01-081-2638) **8920A**

8920A, 8921A & 8922A Wideband Digital Voltmeters
True-rms ac with read-out in volts or dB
AC or ac + dc measurements
Autoranging
Selectable dBm reference impedance
Analog display for peak/null adjustments
Rear panel linear analog output (Models 8920A & 8922A)
Relative dB measurements
10 Hz to 20 MHz or 2 Hz to 11 MHz (Model 8922A)
180 µV to 700V

(NSN 6625-01-203-1314) **8921A**

(NSN 6625-01-126-3884) **8922A**

Choice of Bandwidth

Bandwidth capabilities of the 8920 Series Voltmeters encompass many applications, from testing high-frequency oscillators, attenuator flatness and amplifier frequency response to microphone levels, phono-pickup devices, vibration tests and wideband noise levels to list only a few. Models 8920A and 8921A cover a bandwidth of 10 Hz to 20 MHz. The 8922A offers low-frequency capabilities in the 2 Hz to 11 MHz bandwidth and a switchable 200 kHz low pass filter which eliminates unwanted high-frequency noise from the measured signal.

True-RMS Converter

The heart of all 8920 Series Voltmeters is Fluke's monolithic thermal converter which can measure rms values of an ac signal. This patented semiconductor circuit balances the heating power of a dc feedback signal against the heating power of the ac input voltage, producing a true rms equivalent dc output. This unique converter enables Fluke voltmeters to provide wideband, low-noise, accurate measurements at a low cost.

Selectable dBm Reference Impedance

Fluke's 8920 Series Voltmeters permit an operator to select any one of 12 reference impedances from 50Ω to 1200Ω and to digitally read out dB values referenced to the selected level. Input impedance is constant at 10 MΩ for all settings of the dB reference control. This minimizes circuit loading and allows the operator to add the appropriate termination externally. Zero dB corresponds to 1 mW for each of the selectable levels.

AC or AC + DC Functions

The input coupling capabilities of the 8920 Series Voltmeters help solve difficult measurement problems. Without these features, whenever an operator is required to measure a signal which (1) is not symmetrical, (2) has unequal excursions above and below zero, or (3) has a dc component, it is necessary to go through a series of computations to determine the actual rms voltage value. First, the signal has to be measured with a dc voltmeter (providing its ac rejection is sufficient) and then with an ac voltmeter. Finally, the sum of the squares of the two readings must be calculated and the square-root extracted from the result. Failure to consider the dc component by using only an ac-coupled meter can result in substantial error.

Relative dB Measurements

The relative reference feature of the 8920 Series Voltmeters allows direct readings of gain or attenuation. Depressing the REL switch sets the existing dB reading to zero, establishing the input voltage level as the relative dB reference. Subsequent readings of higher voltages will be displayed as +dB, lower voltages as -dB.

Autoranging

Fluke's autoranging feature allows you to carry out your testing without having to change ranges manually. A range can be placed on HOLD or manually stepped up to a higher range. On HOLD, the meter will remain in a given range regardless of changes in input levels. On STEP UP, the meter will increase ranges step-by-step until the switch is released.

Peaking/Dipping Meter

In addition to an accurate digital display, all Fluke voltmeters in the 8920 Series feature an analog meter for peak and null voltage adjustments. The meter indicates 0 to 100 percent full scale in each range.

Linear Analog Output

Models 8920A and 8922A are equipped with a rear panel output for driving X-Y or strip chart recorders, delivering voltages proportional to the display count. A 2-volt level equals 2000 counts, a 1-volt level equals 1000 counts, etc. This feature is not available on Model 8921A.

Accuracy

Fluke digital voltmeters avoid the possibilities for error so common in analog meters. The digital displays eliminate the likelihood of misreading the meter due to viewing angle problems of parallax common with analog meters. Also, the accuracy of 8920 Series Voltmeters is specified as a percent of reading rather than as percent of full scale.

Percent of reading accuracy does not degrade for measurements at the low end of a scale. Front panel switching offers a choice of readings in dB or volts.

Specifications

Technical Specifications

The accuracy specifications below apply from 9% to 100% of full scale and from 18°C to 28°C for 90 days. For six-month specifications multiply figures by 1.5.

AC Accuracy: ± % of voltage reading or ± dB (8920A & 8921A)

Range	2 Hz	10 Hz	20 Hz	50 Hz	10 kHz	200 kHz	1 MHz	2 MHz	10 MHz	20 MHz
700V 200V	Not Speci-fied	5% or 0.5 dB	1% or 0.15 dB	0.5% or 0.1 dB		0.7% or 0.15 dB	Not Specified			
20V 2V 200 mV							3% or 0.35 dB		5% or 0.5 dB	
20 mV			2% or 0.245 dB	1% or 0.15 dB		2% or 0.25 dB	4% or 0.4 dB			
2 mV			3% or 0.35 dB	2% or 0.25 dB		3% or 0.35 dB				

AC Accuracy: ± % of voltage reading or ± dB (8922A)

Range	2 Hz	10 Hz	20 Hz	50 Hz	10 kHz	200 kHz	1 MHz	2 MHz	11 MHz
	FILTER IN				FILTER OUT				
700V 200V	3% or* 0.35 dB	1% or* 0.15 dB	1% or 0.15 dB	0.5% or 0.1 dB		0.7% or 0.15 dB	Not Specified		
20V 2V 200 mV		5% or 0.5 dB					3% or 0.35 dB	5% or 0.5 dB	
20 mV	5% or 0.5 dB	2% or* 0.25 dB	2% or 0.25 dB	1% or 0.15 dB		2% or 0.25 dB			
2 mV	5% or* 0.5 dB**	5% or 0.5 dB	3% or 0.35 dB	2% or 0.25 dB	4% or 0.4 dB				

**Valid when AC + DC DAMPING is selected and input has no dc components*

***Below 2 mV add number of digits (N) to ±5% voltage readings, where N = 5 ÷ mV input. Or, for dB readings, add N to ±0.5 dB, where N = 0.5 ÷ (mV input)^2.*

AC+DC Accuracy: Add to ac accuracy specifications (above) ±10 digits or ±0.5 dB above 2 mV, or ±100 digits or ±5.0 dB below 2 mV. For dc only, add above digits to 50 Hz to 10 kHz specifications.

Functions: True-rms measurements only. AC or ac + dc (8920A and 8921A); ac or ac + dc with damping (8922A)

Maximum Input: 700V rms or 1000V peak, not to exceed a volt-hertz product of 1×10^8 on any range

Maximum Common Mode Voltage: 400 mV rms or 600 mV peak (8920A & 8922A); 500V rms or 700V peak (8921A)

AC Common Mode Rejection: ≥60 dB at 50 and 60 Hz with 100Ω unbalance

DC Common Mode Rejection: ≥100 dB, 100Ω unbalance

Crest Factor: 7 at full scale, increasing down scale by 7 times the voltage range divided by the voltage input. Degrades below 10 Hz, annunciated when capability exceeded (8922A only).

Input Impedance: 10 MΩ shunted by <30 pF

Voltage Ranges: 2 mV, 20 mV, 200 mV, 2V, 20V, 200V, 700V

Ranging: Autoranging with HOLD to defeat auto ranging and STEP UP for manual ranging. Ranges up at 2000 counts and ranges down at 180 counts.

Decibel Ranges: In the autorange mode, the instrument appears as though it has a single range spanning 131 dB

dBm Reference: Twelve user-selectable impedances are provided to reference a 0 dBm, 1 mW level (50Ω, 75Ω, 93Ω, 110Ω, 124Ω, 135Ω, 150Ω, 300Ω, 600Ω, 900Ω, 1000Ω, and 1200Ω) (dBV = 1000Ω)

Relative dB Reference: A voltage input present when this button is pushed is held as "0 dB" reference point. Subsequent readings indicate ± deviations from this point.

Voltage Resolution: 0.05% of ranges (3½ digits)

Decibel Resolution: 0.01 dB (4 digits)

Typical -3 dB Points: 40 MHz on 20 mV thru 20V ranges and 4 MHz on 2 mV range (8920A/8921A); 22 MHz on 2 mV to 20V ranges (8922A)

Low Pass Filter: Approximately 200 kHz -3 dB point (8922A)

Reading Rate: 2.5/s or 1/s with ac + dc with damping (8922A)

Autorange Rate: <950 ms or <3.5s with ac + dc with damping (8922A)

Response Time: (To rated accuracy) <1.6s or <7s with ac + dc with damping (8922A)

Readout: Panel-selectable for volts or dB, automatic decimal point location: analog peaking/dipping meter

LED Annunciators: Indicate "mV," "V," "dB," "REL REF," and "2 MHz MAX" for 2 mV range (8920A and 8921A) and "UNCAL" when crest factor limitation exceeded (8922A)

Overrange: Flashes maximum reading for that range

Underrange: Flashes decimal

Linear Analog Output: (8920A and 8922A only) Linear output of 2000 mV dc for a 2000-count readout; ±1.0% relative to display; essentially 0Ω output into a ≥10 kΩ load; non-isolated, with output common same as input common

8920A, 8921A & 8922A

Option Specifications

Counter Output Option (-03)

Drives frequency counters. Converts input signal into a 100 mV peak square wave. Greater dynamic range extends the sensitivity of counters to 180 µV at the low end and 700V at the high end. Impedance is 50Ω. Used with the 8921A, counter can measure signals elevated to 500V rms.

Logarithmic Analog Output Option (-04)

For 8920A and 8922A only. Provides an analog output voltage proportioned to the logarithm of the input voltage. Plots logarithmically-scaled graphs, dB variations. Zero volts and zero dB on the output correspond with 200 µV on input. A 13.1V output corresponds to 700V or 131 dB on the input. Therefore, 2V on the output equals 20 dB, 6V equals 60 dB, etc., making it easy to relate voltage to dB. The option provides a low-cost way of using an X-Y recorder to plot graphs as one continuous curve over any part of the 131 dB range.

PTI Interface Option (-521)

To use the 8920 Series DVMs with Fluke's own addressable Portable Test Instrument (PTI) byte-serial data bus. Output to Fluke printers, typically. Supplied with 2-foot ribbon cable Y7203.

1120A Interface Option (-522)

A "personality card" that fits in the Fluke 1120A GPIB/IEEE-488* Translator.

IEEE-488 Interface Option (-529)

The 8920 Series Voltmeters can be made compatible with IEEE Std 488-1978 by using Option -529 in combination with the Fluke Model 1120A Translator. A single 1120A will interface three Fluke instruments to the bus. Option -529 is electrically equivalent to Option -521 plus Option -522. Supports subsets SH1, AH1, T3, TE3.

General Specifications

Temperature: -40°C to +75°C, non-operating
Relative Humidity: <80%
Shock: MIL-T-28800 all classes
Vibration: MIL-T-28800, classes 2, 3 & 4
MTBF: >10,000 hours
Safety: Designed to comply with ANSI C39.5, CSA Bulletin 556B, and FM 3820
Power: 100V, 120V, 220V ac ±10% or 240V ac +4%, -10%, selected by internal switches, 50 to 400 Hz, 10W max
Size: 32.6 cm L x 20.3 cm W x 10.5 cm H (12.9 in L x 8.0 in W x 4.3 in H)
Weight: 2.47 kg (5.44 lb)

Ordering Information

Models

8920A DVM w/BNC Input
8921A DVM w/Banana Jack Inpu
8922A DVM w/BNC Input

Included with Instrument

One-year product warranty, line cord, Instruction manual, and Certificate of Calibration Practices.

Options

-003 Counter Output
-004* Logarithmic Output (not for 8921A
-521 Interface Opt w/PTI Cable
-521K Interface Opt w/PTI Cable, field-installable
-522K 1120A Interface field-installable
-529** IEEE-488 Interface Option w/PTI Cable

**Not compatible with -521, -521K, -529*

***The -529 Option can be ordered and installed at time of manufacture only. For existing instruments which do not have -529 Option installed, an IEEE Interface can be added by ordering -521K and -522K (1120A required).*

Accessories (Also see Section 7)

1120A IEEE-488 Translator
Y7203 Ribbon Cable, PTI 2 ft
Y7204 Ribbon Cable, PTI 5 ft
A90 Current Shunt, 6-Range
80J-10 Current Shunt, 10 Amp
Y9100 BNC 50Ω Attenuator (6 dB)
Y9101 BNC 50Ω Attenuator (14 dB)
Y9102 BNC 50Ω Attenuator (20 dB)
Y9103 50Ω Feedthrough Terminator
Y9107 BNC "T"
Y9109 Banana to BNC Adapter
Y9112 BNC to BNC Cable, 6 ft

Manuals

8920/21A Instruction*
8922A Instruction*

**No charge with purchase of unit*

Customer Support Services

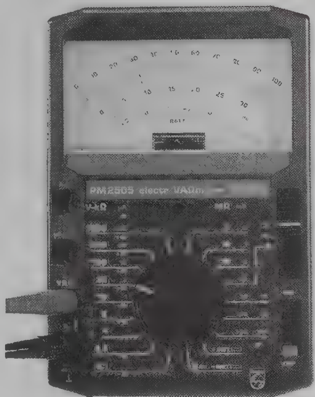
Also see Section 20.

Factory Warranty

One-year product warranty.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 2505



PM 2505

PM 2505 Electronic Multimeter

- 62 measuring ranges, high V and A sensitivity
- 10 MΩ input impedance
- Continuity check by sound signal
- Linear resistance ranges
- Automatic polarity indication

The PM 2505 is an extremely versatile electronic analog multimeter. Built-in features include high accuracy, a good repeatability and a constant input impedance of 10 MΩ. Unlike conventional analog multimeters, which use non-linear reversed scales for resistance measurements, the PM 2505 has an easy-to-read linear scale giving accuracies well in advance of the usual 7 to 10% levels in other analog meters. Moreover, continuity checks (having less than 10Ω approx point-to-point resistance) are simplified by means of a built-in sound signal. A diode measuring facility is provided.

The PM 2505 has a built-in polarity indicator, making it unnecessary to reverse the test leads when making different polarity checks and helping the user when making zero adjustments. The instrument is robust, immune to external magnetic interference and does not radiate magnetic fields. The up-to-date electronic circuitry ensure minimal power consumption, delivering an estimated life for the two 9V batteries of 1000 hr (equivalent to 6 months of continuous everyday use). Additionally, full overload protection is provided on all ranges.

Specifications

Technical Specifications

DC Voltage

Ranges: 100 mV to 1000V
Sensitivity: 1 mV
Accuracy: 1.5% (f.s.d.)
Input Impedance: 10 MΩ // 75 pF
SMMR: >60 dB (50 Hz to 60 Hz)
Maximum Input Voltage: 1000 Vrms

AC Voltage

Ranges: 100 mV to 1000V
Sensitivity: 1 mV
Accuracy: 2.5% (f.s.d.) at 50 to 60 Hz
Input Impedance: 10 MΩ//75 pF
Maximum Input Voltage: 600 Vrms
Frequency range: 10 Hz to 30 kHz

DC Current

Ranges: 1 μA to 10A
Sensitivity: 10 nA
Accuracy: 1.5% f.s.d.
Voltage drop: <100 mV + I x 3.1Ω
Protection (fuse): Ranges 1 μA to 300 mA

AC Current

Ranges: 1 μA to 10A
Sensitivity: 10 nA
Accuracy: 3%
Voltage drop: <100 mV + I x 3.1Ω
Protection (fuse): Ranges 1 μA to 300 mA
Frequency range: 10 Hz to 2 kHz

Resistance

Ranges: 100Ω to 30 MΩ
Sensitivity: 1Ω
Accuracy: 3% f.s.d. up to 10 MΩ, 10% f.s.d. at 30 MΩ
Max. Measuring Voltage: 100 mV up to 100 kΩ, 1V at 1 MΩ and higher
Max. Measuring Current: 316 μA

Continuity Check

Audio Signal At: <20Ω

Diode Check

Measuring Current: 316 μA
Measuring Voltage: 1V

General Specifications

Power Supply: 2 batteries (6F22 HD)
Battery Operating Life: approx.1000h

Environmental Conditions

Reference Temperature: 23°C ±2°C
Range of Operation: 0°C to ±55°C
Storage and Transport: -40°C to +70°C
Humidity Operating Limits: 10 to 90% at <35°C

Size: 172 mm H x 118 mm W x 60 mm D (6.88 in H x 4.72 in W x 2.4 in D)
Weight: 0.7kg (1.5 lb)

Ordering Information

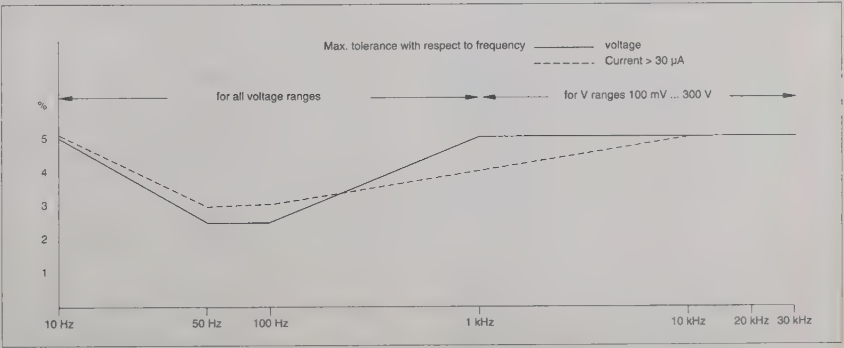
Model

PM 2505/04* Electronic Multimeter
**Available in Europe only*

Included with Instrument
Set of test leads with probes (PM 9266), operating and service manual, spare fuse 400 mA (2)

Accessories (Also see Section 7)
PM 9071 Measuring Cable 135Ω Banana (m) - Banana (m)
PM 9072 Measuring Cable 135Ω BNC (m) - Banana (m)
PM 9111/01 Power Supply 9V DC
PM 9210 High Frequency 150 mV Probe, 10 kHz to 1 GHz
83RF High Frequency Probe, 100 MHz
PM 9213 High Frequency Probe, 100 kHz to 100 MHz
PM 9244 AC and DC Current Shunt up to 31.6A
PM 9245 AC Current Transformer 10A to 150A
PM 9246/04 High Tension Probe
PM 9278/02 Ever-ready Case

Manuals
PM 2505 Operator* (PN 858324)
PM 2505 Service* (PN 220165)
** No charge with purchase of unit*

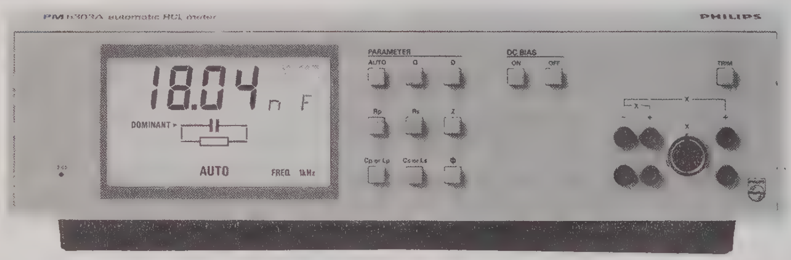


Automatic RCL Meter

PM 6303A

Available through Distributors

NEW



PM 6303A

PM 6303A Automatic RCL Meter

- Big backlit, easy to read, LCD display
- Fully automatic and direct access to all parameters
- Fast display of component value, dimension and equivalent circuit
- Automatic zero trimming of test fixture
- Optional 4-wire test adapter for standard leaded components
- Optional fixture for fast, easy SMD testing
- Optional 4-wire Kelvin clip cable

Fast Operation, Clear Display

The new PM 6303A offers fast and simple determination of the value and electrical characteristics of any passive component or circuit. Results are displayed on a large backlit LCD display.

The PM 6303A's easy operation and instant results make it an ideal tool for incoming inspection and service, where it allows quick determination of whether components are within their specified values, or identification of unknown components.

Other likely application areas for this versatile instrument include education and training, quality control, batch sampling and troubleshooting.

Complete Information Display in Less than a Second

All that is necessary to perform a test is to connect the unknown component or passive circuit, using either a 2- or 4-wire technique, select the test parameter, and complete information about component characteristics is displayed in less than a second.

Dominant component values are measured to an accurary of greater than 0.25%, while at the same time the display shows the relevant electrical dimension and one of seven equivalent circuit diagrams.

Testing of unknown components is further simplified by the AUTO mode button, which gives an immediate display of the dominant value of the component, without the need for further setup.

Any of 8 specific parameter tests, with or without DC-bias, can be directly selected at the touch of a button.

These include serial and parallel resistance, impedance, capacitance, inductance, dissipation and quality factors and phase angle.

Even a 2 Vdc bias test is provide specifically for measuring electrolytic capacitors.

Large LCD Display

A simple user interface allows direct access to all parameters for fast, efficient setting-up of tests. The large backlit display is even clearer, and allows results to be readout at-a-glance.

Another enhancement in the PM 6303A is zero trimming to keep accuracy high. This is performed automatically when the 'trim' key is pressed, for example to compensate for parameters like stray capacitance and residual inductance of different test adapters.

Simple SMD Testing, Too!

The PM 6303A is perfect for fast, easy 4-wire testing of miniature SMDs (Surface Mounted Devices), using the optional test fixture PM 9542SMD and the PM 9542A univeral test adapter.

The universal test adapter (PM 9542A) also allows easy 4-wire testing of conventional components.

Test Cable with Kelvin Clips (PM 9541A)

When making measurements of in-circuit components, connection between the PM 6303A and the component to be tested is easy with the 4-wire test cable PM 9541A.

Specifications

Technical Specifications

Display: Large backlit, 4-digit LCD
Dimension Indications: Ω, kΩ, MΩ, pF, nF, µF, mF, µH, mH, H, kH,DEG
Out of Range Indication: 4 middle digit segments flashing
Equivalent Circuits: 7 equivalent circuits

Measuring Functions & Ranges

Resistance (Rp,Rs, Z)	0.000Ω to 200 MΩ
Capacitance (Cp,Cs)	0.0 pF to 100 mF
Inductance (Lp,Ls)	0.0 µH to 32 kH
Q and D Factor (Q,D)	0.002 to 500
Phase Angle	-90 to +90 degree

Maximum Resolution

Resistance	1 mΩ
Capacitance	0.1 pF
Inductance	0.1 H
Q and D Factor	0.001
Phase angle	0.1 degrees

Measurement Parameters

Measuring Accuracy: ±0.25% ±1 digit
Measuring Frequency: 1 kHz ±0.025%
DUT stress: ≤5 mA, ≤2V (linked to a 2 Vrms source with an internal resistance of 400Ω)
Measurement Update Rate: approx. 2 measurements/s

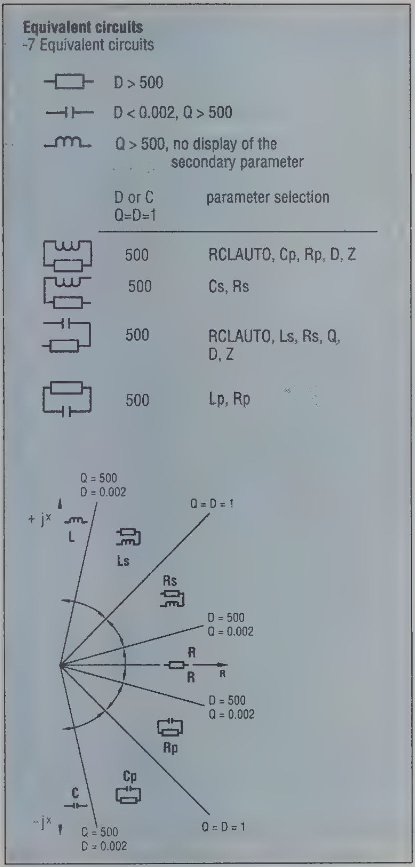
Connectors

2 mm sockets - 2x2 red sockets for measuring voltage (Hi) drive and sense connection; 2 black sockets for measuring current (Lo) drive and sense connection.
8-pin connector for PM 9541A or PM 9542A

Power Requirements

Voltage: 110, 120, 220, 240V ±10%
Frequency: 50 to 100 Hz ±5%
Power Consumption: 12W

PM 6303A


Equivalent circuits
-7 Equivalent circuits
D > 500
D < 0.002, Q > 500
Q > 500, no display of the secondary parameter
D or C
Q=D=1
parameter selection
500
RCLAUTO, Cp, Rp, D, Z
500
Cs, Rs
500
RCLAUTO, Ls, Rs, Q, D, Z
500
Lp, Rp
Q = 500
D = 0.002
Q = D = 1
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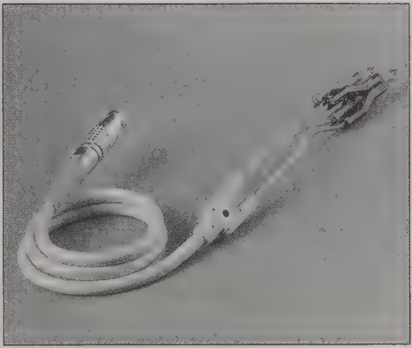


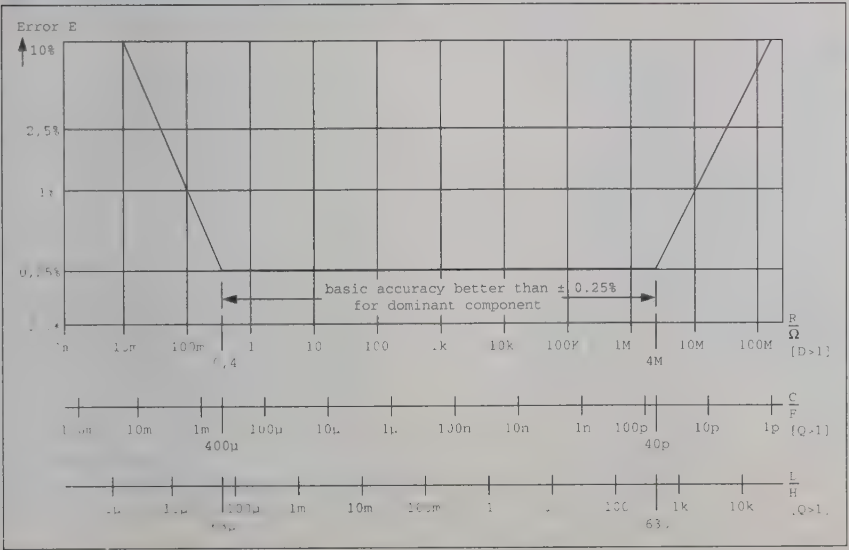
PM 9542A RCL adapter
PHILIPS

	PM 9541A	PM 9542A*
Performance characteristics:		
DUT-connection	by two Kelvin clips	by Kelvin contacts in the test pods
Short-circuit inductance	0.1 µH typical 0.3 µH max.	<0.1 µH
Mechanical specifications:		
Cable length	600 mm	600 mm
Case dimension	—	50H x 145W x 95D mm
Weight	0.2 kg	0.6 kg

**Alone or combined with 9542SMD*

Environmental Capabilities

Ambient Temperatures
Reference Value: +23°C ±1°C
Operation: 0°C to +40°C
Storage and Transport: -40°C to +70°C
Size: 315 mm W x 105 mm H x 405 mm L (12.4 in W x 4.13 in H x 15.9 in L)
Weight: 3.8 kg (8.4 lb)



Ordering Information

Model

PM 6303A Automatic RCL Meter

Included with Instrument
2 single test posts (red and black), operating manual, operating card, line cord and certificate of calibration practices.

Accessories
PM 9541A Four-wire Test Cable
PM 9542A RCL Test Adapter
PM 9542SMD SMD Adapter for PM 9542A
PM 9564 Rack Mount Kit (for PM 6303A manufactured after Nov 1992)

Manuals
PM 6303A Operator*
PM 6303A Operator
PM 6303A Service

**No charge with purchase of unit*

AVAILABLE THROUGH DISTRIBUTORS

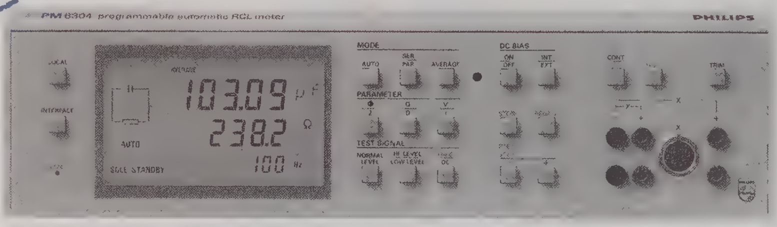
Automatic RCL Meter

PM 6304

GPIB
IEEE-488

RS-232

NEW



PM 6304

PM 6304 Automatic RCL Meter
204 test frequencies, from 50 Hz to 100 kHz
0.1% basic accuracy
DC resistance measurements (optional)
RS-232 and IEEE-488 interfaces (optional)
3 test levels: 2V, 1V, and 50 mV rms
2V dc internal bias and external bias to 40V dc
9 front panel set-ups in memory; recall last set-up on power up
Actual component test voltage/current readback

A Versatile Component Measurement System

The PM 6304 combines excellent component measurement power and versatility with remote programmability. Operation is as simple as ever – just connect the component to the test posts or fixture, and you can instantly read out the dominant and secondary values and see the equivalent circuit diagram on the large LCD display. The available options, from GPIB/IEEE-488* or RS-232 interfaces, DC resistance, component handler interface, and *Inspector* software, add up to a very powerful component test system – from the development lab right through to the production line.

More Measurement Capability

The PM 6304 has the test frequencies you need, more test frequencies than any other competitor in this class of instrument. For testing primary power components, such as filter capacitors, the PM 6304 has 50 and 60 Hz, along with the 100 Hz and 120 Hz ripple frequencies. In the 100 Hz to 20 kHz range, the PM 6304 provides 100 Hz resolution for precision frequency characterization. For testing small value capacitors, 100 kHz is also provided.

Component test voltage levels are selectable from 1V or 2V for standard component testing to 50 mV to keep sensitive semiconductor junctions below their voltage thresholds. DC bias can be added, either from the built-in 2V dc source or from an external source up to 40V dc.

Measuring the DC resistance of a component can be done with the optional DC resistance capability. Measurements comparing the DC and AC resistance values of a component can now easily be done with the push of a front panel key.

Select the Test You Need

Besides the fully automatic operation that displays the dominant parameters and component models, the user can manually select the parameters of interest. Press a key to lock in component phase angle, impedance, Q (quality) and D (dissipation) factors.

Select the current/voltage monitoring function to see the actual test current and voltage values measured at the component under test. This ensures maximum protection for current-sensitive components and allows the test current to be specified together with the measured component parameters.

With all these built-in capabilities, the PM 6304 is a compact and versatile meter that you can use wherever it is needed. And with the best measurement versatility and value in its class.

Computer-Aided Component Test

The optional RS-232 or IEEE-488 interfaces and *Inspector* test software make the PM 6304 a cost-effective solution for automated test set-ups such as an incoming inspection or quality assurance station in manufacturing. With the IEEE-488 interface, the PM 6304 can for the heart of a fully automated component test environment for speeds up to 10 measurements per second. Or with the RS-232 interface, the PM 6304 can be controlled simply and economically from a PC in a stand-alone system for incoming inspection of components and devices. With *Inspector*, just recall an instrument set up from a stored file. Now, start testing components while Inspector acquires the data. This data can now be archived, analyzed for pass/fail conditions, or plotted on the screen for visual analysis. The data can also be exported in standard Lotus or Microsoft Excel formats for your favorite graphics or SQC package.

Component Binning

If your application involves component sorting – for example for incoming inspection – you'll find the handheld bin programmer and handler interface options a big time saver. Program the tolerance limits to sort components into as many as ten bins. The binning limits can also be programmed, archived, and recalled from a PC using *Inspector* software.

Fast Set-up and Calibration

Closed-case calibration can be performed with the handheld in programmer or via the optional RS-232 or IEEE-488 interfaces. All you need are 100Ω and 10 kΩ reference resistors for quick and complete calibration of the instrument.

Connection of test components is quick and simple; either directly to the detachable test posts which are conveniently located on the front panel, or using the PM 9542A universal test adapter or PM 9541A test cable with Kelvin clips.

Easier SMD Testing Too

Testing surface mount devices has always been a challenge, with small physical size, no wire leads, and with tiny markings, if there are any markings at all. The PM 9542SMD SMD test fixture is a unique design that allows fast, accurate characterization of most passive SMD components.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Automatic RCL Meter

PM 6304

Specifications

Technical Specifications

AC Test Mode

Test Frequencies: 50, 60, 100, 120 Hz, 200 Hz to 20 kHz (100 Hz steps), 100 kHz
Test Frequency Accuracy: 0.01%
Total Test Frequencies: 204
Test Signal Levels: 2V via 400Ω source, 1V via 100Ω source, 50 mV via 100Ω source

Basic Measurement Accuracy
(2 readings/second)
≤20 kHz: 0.1% (1V or 2V level), 0.5% (50 mV)
100 kHz: 0.4% (1V or 2V level), 2.0% (50 mV)

DC Test Mode (optional)

Test Signal Levels: 2V via 400Ω, 1V via 100Ω, 300 mV via 100Ω

DC Bias
Internal: 2V dc ±5%
External: 0 to 40V dc

Maximum Measuring Ranges

R or Z	0.0000Ω to 200 MΩ
R (dc)	0.0000Ω to 50 MΩ
C	0.00 pF to 31.8 F
L	0.00 µH to 637 kH
Q	0.000 to 1000
D	0.000 to 1000
ø	-179.0° to +180.0°
V monitor	0.1 µV to 2.00V
I monitor	0.005 µA to 10.0 mA

Maximum Resolution

R or Z	0.1 mΩ
R (dc)	0.1 mΩ
C	0.01 pF
L	0.01 µH
Q	0.001
D	0.001
ø	0.1°
V monitor	0.1 µV
I monitor	0.001 µA

Circuit Diagram: 7 different equivalent circuit diagrams

Auto Mode

Readout: Dominant and secondary values
Equivalent Circuit Diagram: Parallel for R+C, Series for R+L

Manual Mode

Readout: Dominant and secondary values
Equivalent Circuit Diagram: Series or parallel mode selectable

Average Function: Exponential averaging in continuous mode
Measurement Update Rate: 2 measurements/second; 10 measurements/second via interface

Normal Measuring Mode

Continuous: 2 meas/sec
Single Triggered: via "TRIG" key; via handler interface (option); via IEEE-488 or RS-232
Test Frequencies: 50, 60, 100, 120 Hz; 200 Hz to 20 kHz (100 Hz steps); 100 kHz; dc (optional)
Readout: Display or via IEEE-488 or RS-232

Fast Measuring Mode

Continuous: 10 meas/sec
Single Triggered: via handler interface; via IEEE-488 or RS-232
Test Frequencies: 200 Hz to 20 kHz (200 Hz steps); 100 kHz
Readout: via IEEE-488 or RS-232 (display blanked)

Binning

Standard Bins: 9
Special Bins: Bin "0" and bin "fail"
Bin Programming Via: PM 9559 handheld controller; PM 9548 GPIB interface; PM 9549 RS-232 interface
Bin Limit Programming: Absolute or relative
Trim Functions: Open circuit compensation, >100 kΩ; short circuit compensation, <10Ω

Protection Against Charged Capacitors
$C < 2\ \mu F$: Vmax < 500 V
$2\ \mu F \leq C \leq 2\ mF$: $V_{max} < 23.3 * C^{0.234}$ (C in Farads)
$C > 2\ mF$: Vmax < 100V

Stored Settings (non-volatile memory)
Front Panel Settings: 9+1 (trim data included)
Bin Settings: 9+1

Print Measurement Results: Via RS-232 "talk only mode" direct to printer

Calibration

Calibration Interval: 1 year
Required for Calibration: One of the following: PM 9559 handheld controller; PM 9548 GPIB interface; PM 9549 RS-232 interface

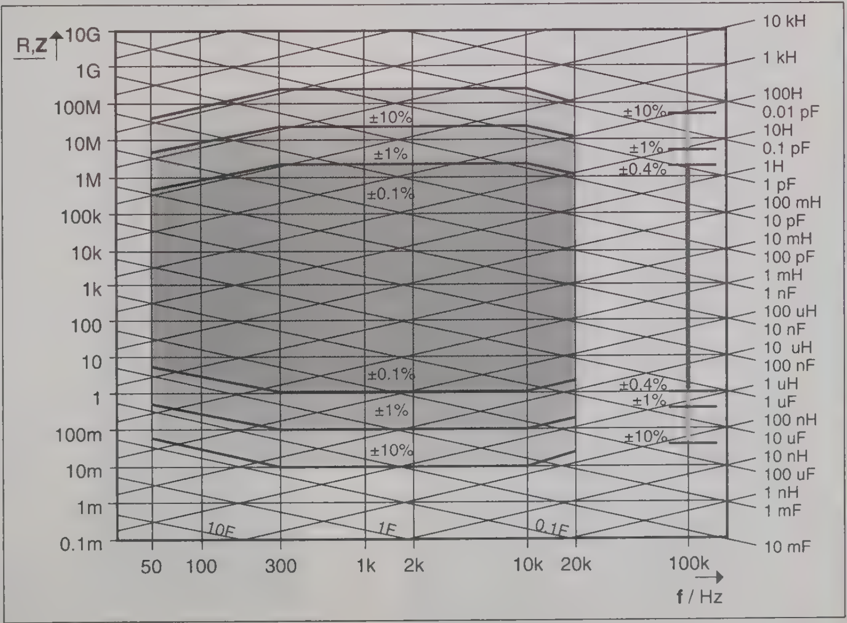
Options

PM 9548 IEEE Interface Kit
Signals: All optically isolated
Control Capability: All functions
Address Range: 1 to 30

PM 9549 RS-232 Interface Kit
Signals: All optically isolated
Mode: Communication mode
Printing Mode
Control Capability: All functions
Baud Rates: 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200
Connector: 9-pins D-connector, male

PM 9565 DC Measurement Option Kit
Technical Specification: See "DC test mode"

PM 9566 Handler Interface
Signals: All optically isolated
Inputs: Trigger input
Outputs: Bin 0-9, FAIL indication



Accuracy PM 6304 (ac test signal 1V, normal measuring speed)

Automatic RCL Meter

PM 6304

Environmental Data

Operating Temperature: 0°C to 50°C
Storage Temperature: -40°C to +70°C
Power Requirements: 100V/120V/220V/240V ±10%
Line Frequency: 50 Hz/60 Hz
Power Consumption: 31 VA
Safety: IEC 348, CSA C22.2 No. 231
Warm-Up Time: 5 minutes

Size: 105 mm H x 315 mm W x 405 mm L (4.13 in H x 12.4 in W x 15.9 in L)
Weight: 4.7 kg (10.4 lb)

Ordering Information

Model

PM 6304 Automatic RCL Meter

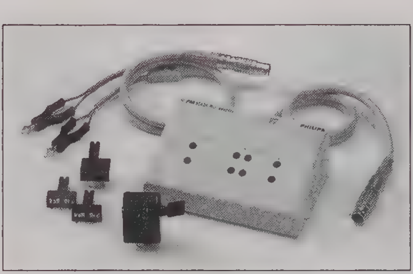
Included with Instrument
One-year product warranty, front panel 4-wire test points.

Factory Installed Options
When ordering use PM 6304 as your prefix, then select your desired 3-digit suffix from below:

/00. RCL Meter
/02. RCL Meter w/GPIB Interface
/03. RCL Meter w/RS-232 Interface
/04. RCL Meter w/DC Measurement Unit
/06. RCL Meter w/DC Measurement Unit and GPIB Interface
/07. RCL Meter w/DC Measurement Unit and RS-232 Interface
/50. RCL Meter w/Handler Interface
/52. RCL Meter w/Handler Interface and GPIB Interface
/53. RCL Meter w/Handler Interface and RS-232 Interface
/54. RCL Meter w/Handler Interface and DC Measurement Unit
/56. RCL Meter w/Handler Interface, DC Measurement Unit and GPIB Interface
/57. RCL Meter w/Handler Interface, DC Measurement Unit and RS-232 Interface

Options (customer installable)
PM 9548 GPIB Interface*
PM 9549 RS-232 Interface*
PM 9559 Handheld Bin Programmer
PM 9565** DC Resistance Measurement
PM 9566 Handler Interface
PM 2272 Inspector Software

**Only 1 interface may be installed in the instrument at one time*
***Recalibration required after installation*



Accessories
PM 2272 Inspector Software
PM 2295/10 IEEE-488 Cable, 1m
PM 2295/20 IEEE-488 Cable, 2m
PM 9536 RS-232 Cable, 3m, 9 pin female/ 9 pin female
PM 9541A 4-Wire Test Cable, DUT Connection 2 Kelvin Clips, cable length 600 mm
PM 9542A 4-Wire RCL Adapter, DUT Connection, Kelvin Contacts in Test Posts, cable length 600 mm
PM 9542SMD 4-Wire SMD Adapter for PM 9542A DUT Connection, Kelvin Contacts within SMD Adapter, DUT length: min 2 mm, max 10 mm; DUT width: min 1 mm; DUT height: min 0.5m
PM 9559 Bin Programmer
PM 9564 Rack Mount Kit 2E (88.5 mm) height

Manuals
PM 6304 Operator*
PM 6304 Programming
PM 6304 Reference
PM 6304 Service
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

	With factory installed option(s):			
Type Number	**Handler Interface**	**DC Unit**	**IEEE Interface**	**RS-232 Interface**
PM 6304/00.				
PM 6304/02.			X	
PM 6304/03.				X
PM 6304/04.		X		
PM 6304/06.		X	X	
PM 6304/07.		X		X
PM 6304/50.	X			
PM 6304/52.	X		X	
PM 6304/53.	X			X
PM 6304/54.	X	X		
PM 6304/56.	X	X	X	
PM 6304/57.	X	X		X

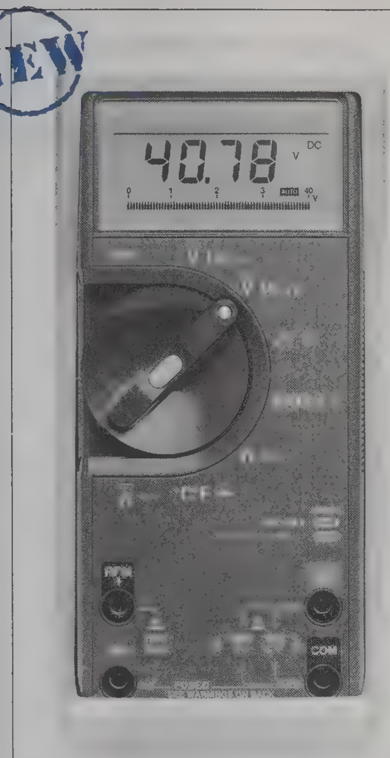
The last digit of the type number is the indication for the local line voltage and local line cord. Following line voltage settings plus line cord are available:

.=1	Universal European 220V
.=3	Standard North America 120V
.=4	United Kingdom 240V
.=5	Switzerland 220V
.=8	Australia 240V

Example: PM 6304/573

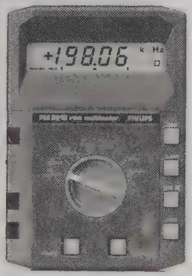
Programmable RCL meter PM 6304 with "handler interface", "DC measurement unit" and "RS-232 interface" installed. Standard North American line cord.

Handheld Multimeters



Fluke 78 Page 111

Fluke 33 Page 105



PM 2618 Page 129

FLUKE 12 MULTIMETER
40.12 V
MAX

Fluke 12 Page 108

Fluke 79 Page 121

Fluke handheld digital multimeters (DMMs) all operate from small, self-contained batteries. Some can also be operated from ac power using a battery eliminator.

Many Fluke handheld DMMs rival the performance of more expensive bench models. Others have features that make them uniquely suited for particular applications for industries. For example, the Fluke Model 25 and 27 are sealed against rain and moisture and can be used at temperatures well below freezing. The Fluke Model 87 can capture the value of high momentary motor-starting currents. The PM 2618/323 mAs meter is ideally suited for medical x-ray applications. The Fluke 8060A and Fluke 87 can read the frequency of telephone touchtone signals.

Fluke handheld multimeters are designed to take electrical and physical abuse with little or no damage.

Selection Guide Page 104
Handheld Multimeters Page 105

Handheld Multimeters

Handheld Multimeters Selection Guide

Models	Basic Features		Special Features												DC Volts**		AC Volts*					AC/DC Amps		Ohms, etc.				
	Max Display Counts*	Autoranging	Analog Bar Graph	Frequency Measurement	dB, dBm Readout	Offset/Relative Ref	Continuity & Beeper	Peak-Hold, AC/DC	Touch-Hold	Sealed Case Water/Chemical Resistant	Min/Max Hold	Milliamp Seconds (mAs)	Capacitance 5.00 nF to 5.00 µF	Duty Cycle 0.0 to 99.9%	Basic Accuracy, %	Max Resolution, µV	Max AC Voltage, w/o Probe (RMS)	True-RMS	Basic Accuracy, %	Max Resolution, µV	Frequency Range, Hz	Max Resolution, µA	Max Amps, w/o Probe	Max Resolution, mΩ	Max Resistance, MΩ	Diode Test	Conductance (Low) >20 MΩ	Page Number
Fluke 10	4000	(1)	—	—	—	—	•	—	—	—	—	—	—	—	1.5	1k	600	—	2.9	1k	400	—	—	100	40	•	—	108
Fluke 11	4000	(1)	—	—	—	—	•	—	—	—	—	—	(9)	—	0.9	1k	600	—	1.9	1k	400	—	—	100	40	•	—	108
Fluke 12	4000	(1)	—	—	—	—	•	—	—	—	•	—	(9)	—	0.9	1k	600	—	1.9	1k	400	—	—	100	40	•	—	108
Fluke 31	4000	(1)	•	•	—	—	(10)	—	•	—	—	—	—	—	—	—	—	—	—	—	—	(8)	700	—	—	—	—	105
Fluke 33	4000	(1)	•	•	—	—	(10)	(8)	•	—	•	—	—	—	—	—	—	—	—	—	—	(8)	700	—	—	—	—	105
Fluke 70	3200	(1)	•	—	—	—	•	—	•	—	—	—	—	—	0.5	100	750	—	2.0	1k	1k	—	—	100	32	•	—	119
Fluke 73	3200	(1)	•	—	—	—	•	—	•	—	—	—	—	—	0.4	100	750	—	2.0	1k	1k	10k	10	100	32	•	—	119
Fluke 75	3200	(1)	•	—	—	—	•	—	•	—	—	—	—	—	0.4	100	750	—	2.0	1k	1k	10	10	100	32	•	—	119
Fluke 77	3200	(1)	•	—	—	—	•	—	•	—	—	—	—	—	0.3	100	750	—	2.0	1k	1k	10	10	100	32	•	—	119
Fluke 78	4000	(1)	•	•	—	—	•	—	•	—	•	—	—	•	0.3	100	500	—	2.5	1k	1k	10k	10	100	40	•	—	111
Fluke 79	4000	(1)	•	•	—	—	•	—	•	—	—	—	(7)	—	0.3	10	750	—	1.9	100	1k	1	10	10	40	•	—	121
Fluke 21	3200	(1)	•	—	—	—	•	—	•	—	—	—	—	—	0.4	100	750	—	2.0	1k	1k	10	10	100	32	•	—	119
Fluke 23	3200	(1)	•	—	—	—	•	—	•	—	—	—	—	—	0.3	100	750	—	2.0	1k	1k	10	10	100	32	•	—	119
Fluke 25	3200	(1)	•	—	—	—	•	—	•	•	—	—	—	—	0.1	100	1000	—	0.5	100	30k	0.1	10	100	32	•	•	123
Fluke 27	3200	(1)	•	—	—	•	•	—	•	•	•	—	—	—	0.1	100	1000	—	0.5	100	30k	0.1	10	100	32	•	•	123
Fluke 29	4000	(1)	•	•	—	—	•	—	•	—	—	—	(7)	—	0.3	10	750	—	1.9	100	1k	10	10	10	40	•	—	121
Fluke 83	4000	(1)	•	•	—	•	•	—	•	(5)	(6)	—	•	•	0.3	100	1000	—	1.0	100	5k	0.1	10	100	40	•	•	116
Fluke 85	4000	(1)	•	•	—	•	•	—	•	(5)	(6)	—	•	•	0.1	100	1000	—	0.5	100	20k	0.1	10	100	40	•	•	116
Fluke 87	4000	(1)	(4)	•	—	•	•	•	•	(5)	(6)	—	•	•	0.1	10	1000	•	0.7	10	20k	0.1	10	100	40	•	•	116
Fluke 88	4000	(1)	(4)	•	—	•	•	—	•	(5)	(6)	—	—	•	0.15	100	1000	—	1.5	100	5k	0.1	10	100	400	•	—	114
8025B	3200	(1)	•	—	—	•	•	—	•	•	•	—	—	—	0.2	100	1000	—	0.5	100	30k	0.1	10	100	32	•	•	125
8060A	20,000	—	—	•	•	•	•	—	—	—	—	—	—	—	0.04	10	750	•	0.2	10	100k	0.01	2	10	300	•	•	126
8062A	20,000	—	—	—	—	•	•	—	—	—	—	—	—	—	0.05	10	750	•	0.5	10	30k	0.01	2	10	300	•	—	126
PM 2518	2K/11K	(1)	•	—	•	•	•	—	—	—	—	—	—	—	0.1	100	750	(2)	0.5	100	40k	10	10	100	100	•	—	129
PM 2618	2K/11K	(1)	•	•	•	•	•	—	—	—	—	(3)	—	—	0.07	100	750	(2)	0.4	100	70k	10	10	100	100	•	—	129
PM 2718	2K/11K	(1)	•	•	•	•	•	—	•	—	(6)	—	—	—	0.04	100	750	(2)	0.3	100	100k	10	10	100	100	•	—	129

• Standard
— Not applicable
** All displays LCD*
*** Max DC Voltage w/o Probe 1000V*
(1) Or manual ranging
(2) AC Coupled
(3) For PM 2618/323
(4) Analog Pointer
(5) Splash and dust proof
(6) MIN/MAX Average
(7) 99.9 nF to 999.9 µF (specified accuracy) usable to 9999 µF
(8) AC amps only
(9) 1.000 µF to 999 µF (specified accuracy) usable to 9999 µF
(10) Beeper in record mode, overload and incorrect sequence selection

For Bench/System Multimeters see Section 4.
For Multimeter Accessories see Section 7.

30 Series Current Master™

Available through Distributors

FLUKE 31
0.00A

Fluke 31

Fluke 33

30 Series Current Master™
31 and 33
True-rms current measurement for testing non-linear and traditional loads
Frequency measurement (Hz)
Hand Guard – For prevention of accidental contact with conductors
Display Hold
Combination Digital/Analog Display
Power-Up Self Test – Verifies proper functioning and estimates battery life
Beeper provides audible feedback
Clip on holster
Auto and Manual Ranging
33 Only
Min/Max – Records maximum, minimum, and average frequency or RMS current
Crest – half cycle peak current readings
Smooth: 3 second running average of RMS current or frequency

Measuring current accurately is a difficult job in today's industrial plants and commercial buildings. An increasing number of personal computers, adjustable speed motor drives, and other types of electronic equipment come on-line every day. These devices draw current in short pulses, and are referred to as non-linear loads.

Non-linear loads draw high peak currents, causing harmonics in the load current. This may result in unexplained circuit breaker tripping, or dangerous overheating of neutral conductors and transformers. Currents containing harmonics can only be accurately measured with a true-rms meter or clamp meter.

The Fluke 31 and 33 Current Masters offer the combination of true-rms measurements and rugged reliability needed to troubleshoot problems associated with both traditional and non-linear loads.

True-RMS Current

For years average-sensing meters have provided a reliable measurement solution, but that time has passed. Average-sensing meters cannot accurately measure the effects of harmonics caused by today's non-linear loads. They give readings that may run from 30% to 50% low, making effective troubleshooting impossible.

The Fluke 30 Series Current Masters feature true-rms capability to accurately measure currents – with or without harmonics – up to 700A. Their reliable measurements greatly streamline the troubleshooting of power distribution systems, and installing or repairing adjustable speed motor drives.

Frequency (Hz)

Helps detect the presence of harmonics in neutral currents and determine whether they result from unbalanced phases or non-linear loads. The 30 Series has a noise-rejecting auto-trigger which allows it to easily measure the frequency output of current on adjustable speed motor drives. This function can also be used to set frequency on generator sets.

The analog bar graph continues to display real-time current measurements while reading frequency on the digital display. This allows simultaneous monitoring of current loads and frequency.

In addition to true-rms and frequency measurements, the Fluke 30 Series Current Masters offer a comprehensive set of features.

Designed for Real World Use

Rugged angular jaw can safely pry into tight spaces. Safety-designed hand guard helps prevent accidental contact with conductors. Heavy duty construction withstands job site abuse.

30 Series Current Master

Easy to Use

Simple to operate. Clearly marked function modes prevent operator error. Digital display eliminates the guesswork of interpreting readings while the analog bar graph provides a clear understanding of trends and surge currents.

Combination Digital/Analog Display

Functions and units are clearly displayed for easy operation. The 10,000 count digital display provides exact readings, while the analog bar graph shows trends and surges.

Display Hold

Captures and holds any reading for later viewing when working in difficult-to-reach areas.

Beeper

Confirms key presses with audible feedback. Also indicates new highs and lows while recording overload conditions, and the inaccessibility of certain functions. Signals when exiting Min/Max or the manual range.

Sleep Mode

Extends battery life by automatically switching the unit off if not in use for ten minutes, unless recording in the MIN MAX mode, or disabled during power-up.

Power-Up Self Test

This test ensures all functions are in working order and indicates the amount of remaining battery life.

Autorange/Range

Choice of locking into one of two ranges for a fixed resolution (RANGE) or allowing the meter to measure different levels of current without resetting the range (AUTORANGE).

Distinctive Features (Fluke 33)

CREST (33 Only) Measures the instantaneous peak value of the current waveform with a capture time of 2 ms. This measurement is used to determine crest factor which can indicate the presence of harmonics.

SMOOTH (33 Only) Records a running 3 second average, allowing stable measurements of machinery that draws variable current or fluctuating loads.

MIN MAX RECORD (33 Only) Max can be used to measure the starting current of motors and surge currents. Records over 24 hours, monitors major fluctuations in current or frequency, stores the minimum and maximum values, and determines the average over time.

Specifications

Technical Specifications

Specifications apply to both the Fluke 31 and the Fluke 33 unless otherwise stated. Accuracy is given as [a percent of reading] + [number of least significant digits] at 18°C to 28°C with relative humidity less than 90%

Display

Digital: 10,000 counts, updates 2 times/second
Analog: Updates 8 times/second, 40 segment bar graph

RMS Amperes[1]				
		Accuracy[2]		
Range	Resolution	Basic 45 to 65 Hz	Extended 30 to 45 Hz, 65 to 1000 Hz[3]	Low Frequency 20 to 30 Hz[4]
0.30 to 99.9 (40A Scale)	0.01	±(2% + 20)	±(4% + 30)	±(8% + 30)
0.3 to 399.9 (400A Scale)	0.1	±(2% + 2)	±(4% + 3)	±(8% + 30)
400.0 to 700.0 (400A Scale)	0.1	±5%	±7%	Not specified

[1] *Sine wave, measured with conductor centered at alignment marks and battery life indication greater than 40 hours on meter power up.*
[2] *RMS Min/Max: Add 10 counts.*
[3] *1A and above, 30 to 45 Hz.*
[4] *Model 33 AVG only, 2.5A and above. RMS Min/Max: Add 2% of reading.*

Instantaneous Amperes (Crest Mode)[1]				
		Accuracy		
Range	Resolution	Basic 45 to 65 Hz	Extended 30 to 45 Hz, 65 to 1000 Hz[2]	Low Frequency 20 to 30 Hz[3]
0.4 to 99.99 (40A Scale)	0.2	±(3% + 30)	±(4% + 30)	±(4% + 40)
0.4 to 399.9 (400A Scale)	2	±(3% + 3)	±(4% + 3)	±(4% + 4)
400.0 to 599.9 (400A Scale)	4	±3%	±4%	±4%
600.0 to 999.9 (400A Scale)	4	±7%	±7%	±7%

[1] *Sine wave, measured with conductor centered at alignment marks and battery life indication greater than 40 hours on meter power up.*
[2] *1A and above, 30 to 45 Hz.*
[3] *2.5A and above.*

Frequency[1]		
Measurement Range (Hz)	Resolution (Hz)	Accuracy
0.5 to 999.9 Hz	0.1	±(0.2% + 3)
1000 to 9999 Hz	1	±(0.2% + 3)

[1] *Measured with conductor centered at alignment marks, and battery life indication greater than 40 hours on meter power up. With current autorange: Trigger Level, 5 Hz to 1500 Hz, 0.3A RMS or more, self-adjusting between 1/3 peak and 1/2 peak current. With manual ranging: Trigger Threshold, 10 Hz to 1000 Hz, 40A Range - 6A RMS or more will trigger. 400A Range - 40A RMS or more will trigger.*

30 Series Current Master

General Specifications

Measurement Limits: True rms .2 to 700A (ac only - no dc component)
Maximum Conductor Voltage: 600V rms
Frequency Range for Current Measurements: 10 Hz to 2 kHz
Frequency Range for Frequency Measurements: 0.5 Hz to 10 kHz
Crest Factor, Continuous Waveform: (45 Hz to 65 Hz, less than 1000A peak): 1.4 to 2.0, add 20 digits to accuracy below 100A; 2.0 to 3.0, add 1% to accuracy (+20 digits below 100A); 3.0 to 5.0, add 2% to accuracy (+20 digits below 100A); Operating limitations over 400A and below 45 Hz
Adjacent Conductor Effect: 1% of current in adjacent conductor, maximum
Operating Temperature: -10°C to 55°C
Operating Humidity: 0° to 90% @ 40°C; 75% @ 50°C
Storage Temperature: -40°C to 70°C
Battery Type: 9.0V Alkaline IEC 6LF22 or NEDA 1604A
Battery Life: 80 hours typical (alkaline battery)
Safety: UL 1224, IEC 348/1010, IEC 664 Installation Category III; CSA C22.2 No. 231, ANSI/ISA S82, VDE 0411
Jaw Opening: Will accommodate 2 each 500 mcm cables
Size: 4.39 cm H x 9.7 cm W x 23.15 cm L (1.73 in H x 3.82 in W x 9.11 in L)
Weight: 500g (1.1 lb)

Ordering Information

Models

Fluke 31 Current Clamp with Holster
Fluke 33 Current Clamp with Holster
C30 Replacement Holster

Included with Instrument
One-year product warranty, holster, 9V battery, Quick Reference Guide and Operator manual.

Manuals
Fluke 31/33 Operator*
Fluke 31/33 Quick Reference Guide

**No charge with purchase of unit*

Factory Warranty
One-year product warranty.

AVAILABLE THROUGH DISTRIBUTORS

New Training Video

Understanding Harmonics
...Power Distribution Systems
FLUKE

Understanding Harmonics in Power Distribution Systems.

This informative video provides a basic understanding of power system current harmonics. It includes numerous diagrams and formulas that will take the mystery out of harmonics troubleshooting.

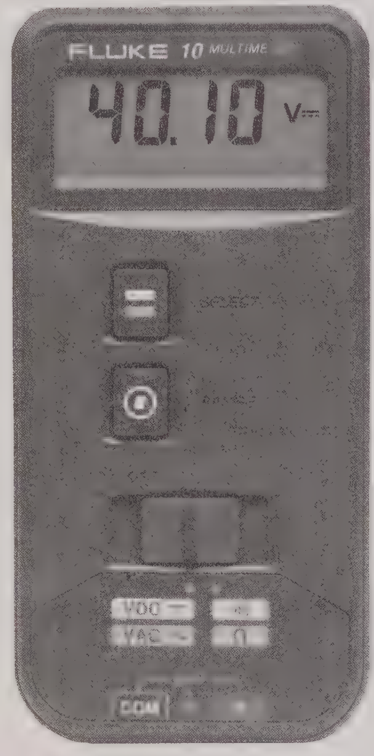
Its straight forward hands-on approach will help you solve many of your most troubling electrical problems.

Specific Topics Include:
- Definition and classification of harmonics.
- Understanding electrical load types.
- Electrical equivalent circuits.
- Finding harmonics.
- Solution and prevention of harmonic problems in new and existing facilities.
- Test equipment requirements for harmonic troubleshooting.

This video can be purchased through your local Fluke distributor or by calling 1-800-526-4731. Ask for part # 926993

Series 10

Available through Distributors


FLUKE 10 MULTIMETER
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VDC
VAC
Ω
COM

LISTED
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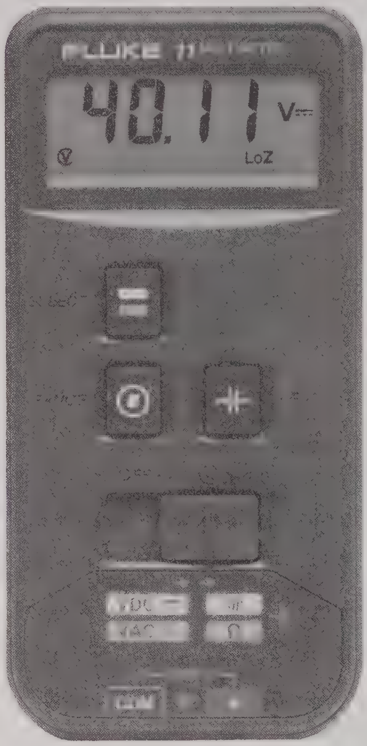
1244

Fluke 10


FLUKE 11
40.11 V
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Ω
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1244

Fluke 11

FLUKE 12 MULTIMETER
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VDC
VAC
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1244

Fluke 12

Fluke 10
4000 count digital display
Sleep mode
Fast continuity beeper
1.5% basic dc volts accuracy
2.9% basic ac volts accuracy
1.5% basic ohms accuracy

Fluke 11
4000 count digital display
Sleep mode
Fast continuity beeper
0.9% basic dc volts accuracy
1.9% basic ac volts accuracy
0.9% basic ohms accuracy
V Chek™
Capacitance, 0.001 to 9,999 µFd

Fluke 12
4000 count digital display
Sleep mode
Fast continuity beeper
0.9% basic dc volts accuracy
1.9% basic ac volts accuracy
0.9% basic ohms accuracy
V Chek™
Capacitance, 0.001 to 9,999 µFd
Min/Max recording
Continuity Capture™
Input change alert
Relative time function

Series 10

The Fluke Series 10 Digital Voltmeter is designed to support first level electrical and electronic troubleshooting with a new measure of speed, versatility and easy, automatic operation for the price. It's designed for true one-hand operation; just turn on the slide switch and use two pushbuttons to switch functions or ranges.

AC and DC Voltage Measurements

Voltage measurements can be made in a wide range of situations, including multi-phase systems up to 600 volts. To yield a direct readout without making a decimal point correction, a 4000 millivolt range is provided.

Fast Continuity Beeper

No need to watch the display when checking continuity. Just listen for the beep, even for continuity as short as 250 µs.

Ohms to 40 MΩ and Diode Test

The Fluke Series 10 measures resistance over a wide range and displays the voltage drop of properly working diodes.

4000 Count Digital Display

Large, ease-to-read-digits gives better resolution than common 1,999-count meters. In fact, for many readings, the Fluke Series 10 gives the resolution of more expensive meters.

Auto and Manual Ranging

For quick reading, the Fluke 10 automatically selects the range with the best resolution for the job. For repetitive measurements, manual ranging can increase the measurement speed.

Reliable By Design

Fluke's superior overload protection and safety-designed test leads are standard with the Fluke 10. It's designed to meet recognized safety standards the world over.

Warranty

Fluke's quality is backed up with a worldwide two year warranty.

V Chek™ (Fluke 11 and 12)

This new and unique feature is an extension of the ohms/continuity function. When the switch is in the ohms/continuity position and there is a voltage greater than 4 volts at the input terminals, the meter will automatically switch to either the ac or dc volts function depending on which is greater. In addition, in this mode the input resistance of the meter is approximately 2 kΩ so the user will know if voltage is from a hard connection and not due to leakage.

Capacitance (Fluke 11 and 12)

Using four ranges of capacitance, the meter has a specified range of 1 µFd to 1,000 µFd. The meter is useable for capacitance measurements up to 9,999 µFd.

Min/Max Monitor (Fluke 12)

The Min/Max mode features an elapsed time clock that will "time stamp" the highest and the lowest display reading during a 100 hour period. When the Min/Max mode is activated in the continuity mode, the meter will capture and symbolically display intermittent opens and shorts as brief as 250 µs duration (Continuity Capture™).

Specifications

Technical Specifications

Accuracy is specified for a period of one year after calibration, at 18°C to 28°C (64°F to 82°F) with relative humidity to 90%. AC conversions are ac-coupled, average responding, and calibrated to the rms value of a sine wave input. Accuracy Specifications are given as: ±([% of reading] + number of least significant digits])

VDC

Overload Protection (nominal): 600V dc
Input Impedance: >10 MΩ <100 pF; in V Chek & Lo Z: >2 kΩ <200 pF*
Common Mode Rejection Ratio (1 kΩ unbalanced): >100 dB at dc, 50 Hz, or 60 Hz
Normal Mode Rejection: >50 dB at 50 Hz or 60 Hz

VAC

Overload Protection (nominal):** 600V rms
Input Impedance (1 kΩ unbalanced): >5 MΩ <100 pF (ac-coupled); in V Check & Lo Z: >2 kΩ <200 pF*
Common Mode Rejection Ratio: >60 dB, dc to 60 Hz

*≈2 kΩ with input voltage to 50V. Impedance will increase to >300 kΩ at 600V.

**3×10^6V Hz maximum

Function	Range	Resolution	Accuracy	
			Fluke 10	Fluke 11 & 12
VAC (50 Hz to 400 Hz)				
	4000 mV*	1 mV	±(2.9% + 3)	±(1.9% + 3)
	4.000V	0.001V	±(2.9% + 3)	±(1.9% + 3)
	40.00V	0.01V	±(2.9% + 3)	±(1.9% + 3)
	400.0V	0.1V	±(2.9% + 3)	±(1.9% + 3)
	600V	1V	±(2.9% + 3)	±(1.9% + 3)
VDC				
	4000 mV*	1 mV	±(1.5% + 2)	±(0.9% + 2)
	4.000V	0.001V	±(1.5% + 2)	±(0.9% + 2)
	40.00V	0.01V	±(1.5% + 1)	±(0.9% + 1)
	400.0V	0.1V	±(1.5% + 1)	±(0.9% + 1)
	600V	1V	±(1.5% + 1)	±(0.9% + 1)
Ω				
	400.0Ω	0.1Ω	±(1.5% + 2)	±(0.9% + 2)
	4.000 kΩ	0.001 kΩ	±(1.5% + 1)	±(0.9% + 1)
	40.00 kΩ	0.01 kΩ	±(1.5% + 1)	±(0.9% + 1)
	400.0 kΩ	0.1 kΩ	±(1.5% + 1)	±(0.9% + 1)
	4.000 MΩ	0.001 MΩ	±(1.5% + 1)	±(0.9% + 1)
	40.00 MΩ	0.01 MΩ	±(1.9% + 3)	±(1.5% + 3)
)))) ─▶├				
	2.000V	0.001V	±(1.5% + 2)	±(0.9% + 2)**
Capacitance				
	1.000 µF	0.001 µF	NA	±(1.9% + 2)†
	10.00 µF	0.01 µF	NA	±(1.9% + 2)†
	100.0 µF	00.1 µF	NA	±(1.9% + 2)†
	1000 µF††	001 µF	NA	±(1.9% + 2)†
	10,000 µF	0010 µF	NA	±(10% + 90) typ†

* *The 4000 mV range can only be entered in manual range mode. Use the 4000 mV range with accessories.*

** *The beeper is guaranteed to come on at <25Ω and turn off at >250Ω. The meter detects opens or shorts of 250 µs or longer.*

† *The accuracy specification is for capacitors that have negligible dielectric absorption. Capacitance measured with RC charge technique that evaluates C=Q/V. Capacitors with non-negligible dielectric absorption can be measured but measurement values may be in error.*

†† *Functionally, 1000 µF is in the same range as 10,000 µF.*

Series 10

Ohms

Overload Protection: 600V rms
Open Circuit Test Voltage: <1.5V dc
Full Scale Voltage
To 4.0 MΩ: <450 mV dc
40 MΩ: <1.5V dc
Short Circuit Current: <500 µA

Diode Test

Overload Protection: 600V rms
Open Circuit Test Voltage: 2.4-3.0V dc
Full Scale Voltage
Short Circuit Current: 0.95 mA

MIN/MAX Recording Accuracy and Response Time (Fluke 12)

Specified accuracy of the measurement function ±12 digits for changes >200 ms in duration (±40 digits in ac). Typical 100 ms response to 80%.

Min/Max Recording with Elapsed Time (Fluke 12)

Elapsed Time: 0 to 100 hours (99.59)
Resolution: 1 minute
Accuracy: 0.3% typical

Continuity Capture (Fluke 12)

Detects opens or shorts of 250 µs or longer

Environmental

Operating Temperature: -10°C to 50°C
Storage Temperature: -30°C to 60°C indefinitely (to -40°C for 100 hours)
Temperature Coefficient: 0.1 x (specified accuracy)/°C (<18°C or >28°C)
Relative Humidity: 0% to 90% (-10°C to 35°C); 0% to 70% (35°C to 50°C)
Shock, Vibration: 1 meter shock. Vibration per MIL-T-28800D for a Class 3 Instrument

General Specification

Maximum Voltage Between any Terminal and Earth Ground: 600V rms
Display: 3³/₄-digits, 4000 counts, updates 4/sec
Battery Type: 9V, NEDA 1604 or IEC 6F22
Battery Life: Alkaline, 650 hours continuous: Carbon-zinc, 450 hours continuous
Safety: Designed to Protection Class II requirement of UL1244, ANSI/ISA-S82, CSA C22.2 No 231, and VDE 0411, and IEC 1010 over voltage category III
EMI Regulations: Complies with FCC Part 15, Class B, and VDE 0871B
Size: 1.35 in H x 2.75 in W x 5.55 in H (34.6 cm H x 70.5 cm W x 142.3 cm H)
Weight: 10 oz. (286g)

Optional C10 holster with tilt-stand available.

Ordering Information

Models

Fluke 10 Multimeter
Fluke 11 Multimeter
Fluke 12 Multimeter

Included with Instrument

Two-year product warranty, one year guaranteed calibration, safety-designed TL75 test leads, 9V battery (installed), and operator's manual.

Accessories (Also see Section 7)
TL20 Industrial Test Leads
TL22 Flexible Test Leads
TL24 Flexible Test Leads (straight)
TL75 Hard Point Test Leads
TP20 Industrial Test Probes
TP80 Electronic Test Probe
AC20 Industrial Test Clips
AC70 Alligator Clips
AC80 Hook-Style Test Clips
AC83 Pin Grabber Test Clips
C10 Holster
C12 Soft Case
80i-KW Current Power Probe
80i-410 AC/DC Clamp-On Current Probe
80i-1010 AC/DC Clamp-On Current Probe
80T-150U Universal Temperature Probe
80TK Thermocouple Module

See pages 145 -146 for a list of temperature probes available.

Manuals
Fluke 10 Operator*
Fluke 11/12 Operator*
Fluke 10/11/12 Service

**No charge with purchase of unit*

AVAILABLE THROUGH DISTRIBUTORS

78

NEW

40.78
V
DC
RPM②
Ω
°C°F
10A
100V MAX
COM
FUSED
SEE WARNINGS ON BACK

Fluke 78

When time is money, it pays to have the right tool for the job. And when your job is getting to the heart of an automotive problem, the right tool is the Fluke 78.

It has everything you need to speed through a wide variety of automotive electronic tests. You can check volts, amps, continuity and resistance for just about everything automotive.

The New Standard in Automotive Testing

The Fluke 78 brings together all the special test-and-measurement features you need to diagnose even the most sophisticated automotive problems quickly and accurately. Including frequency, duty cycle, direct reading dwell, temperature and Min/Max. In addition to the 4000-count digital readout, there's a precision analog bar graph that provides useful trend information for variable signals.

A Technician's Best Friend

Like all Fluke meters, the 78 is rugged, reliable, user-friendly - and very smart:

10 megohm input impedance protects sensitive automotive computer circuitry and provides more accurate measurements by drawing very little power from the device you're testing.

Sleep Mode extends battery life when your Fluke 78 is on but not in use.

Protective Holster with Flex-Stand™ can bend around a hose or be hung from a bolt for use just about anywhere.

A Money-Making Tool

By zeroing in on the problem in less time, the Fluke 78 pays for itself in no time – and makes you more profitable day after day, job after job. For such a low price, why get under the hood without it?

Put Your Fluke 78 to The Test

Get to the heart of the problem the first time – every time – with your Fluke 78 automotive meter. Here are just a few of the fast, accurate diagnostic test you can do to make a difference in your repair time – and your bottom line.

Whether you need to test for ac or pulsed-dc frequency, your Fluke 78 has got you covered. Measure frequency on a crankshaft position sensor using the ac-coupled frequency function – also ideal for measuring vehicle speed sensors and ABS sensors. And it's a quick switch to dc for "pulsed-dc" test on BP/MAP, MAF and Hall sensors.

Measure duty cycle on a feedback carburetor; the Fluke 78 displays, in percent, the time the input signal is below the trigger level is grounded out. (Leaning out the mixture).

Capture Min/Max voltage on an oxygen sensor. The Fluke 78 captures and records the highs and lows of virtually every measurement you can make – including volts, temperature, starting currents (with optional clamp-on current probe) and pressure (with optional PV500 Pressure-Vacuum Module).

Test the ON/Off Temperature of a fan switch – get the answer in °C or °F. The Fluke 78 temperature function is built right in, making it quick and easy to check the temperature of engine transmission oil, coolants and air conditioning. A bead thermocouple probe and adapter plug is included.

The Right Accessories

RPM80 Inductive Pickup converts the magnetic field created by the current in the spark plug wire into a pulse that triggers an RPM measurement.

Note: Some ignition systems can produce signals that are not reliably read by the RPM 80.

DC/AC clamp-on Current Probes expand your Fluke 78 measurement range beyond 10 amps, up to 1000A dc using the 80i-1010.

Additional temperature probes for surface, air and liquid measurements.

PV500 Digital Pressure-Vacuum Module for quick, accurate diagnosis of both automotive pressure and vacuum systems.

Fluke 78 Automotive Meter

- Fast, accurate electronic diagnosis, to check volts, amps, continuity and resistance
- Frequency measurement for "pulsed-dc" test on MAP and MAF sensors
- AC frequency tests of crankshaft position or vehicle speed sensors
- Duty cycle verifies operation of feedback carburetors, electronic EGR valves and other variable duty cycle signals
- Direct reading dwell for 3-, 4-, 5-, 6-, and 8-cylinder engines
- Measures up to 999°F or 980°C
- Min/Max works with all meter functions to record the highest and lowest readings
- Precision analog bar graph provides trend information for variable signals
- Inductive RPM pickup for both conventional and distributorless ignitions
- Three year warranty

Specifications

Technical Specifications

Accuracy is specified as ±([% of reading] + [number of least significant digits]) at 18°C to 28°C (64°F to 82°F) with relative humidity to 95%, for a period of one year after calibration.

78

DC Volts*

Range	Resolution	Accuracy
400.0 mV	0.1 mV	±(0.3% +5)
4000 mV	1 mV	±(0.3% +1)
4.000V	0.001V	±(0.3% +1)
40.00V	0.01V	±(0.3% +1)
400.0V	0.1V	±(0.3% +1)
500V	1V	±(0.3% +1)

**Input impedence: 10 MΩ (nominal), <150 pF*

AC Volts* 10^7 V-Hz Maximum

Range	Resolution	Accuracy
45 Hz to 1kHz		
4.000V	0.001V	±(2.5% +2)
40.00V	0.01V	±(2.5% +2)
400.0V	0.1V	±(2.5% +2)
500V	1V	±(2.5% +2)
To 20 kHz		
–	–	±1.5 dB typ

**Input Inpedence: 10 MΩ (nominal), <150 pF*

Resistance

Range	Resolution	Accuracy
400.0Ω	0.1Ω	±(0.5% +2)
4.000 kΩ	0.001 kΩ	±(0.5% +1)
40.00 kΩ	00.01 kΩ	±(0.5% +1)
400.0 kΩ	000.1 kΩ	±(0.5% +1)
4.000 MΩ	0.001 MΩ	±(0.5% +1)
40.00 MΩ	0.01 MΩ	±(1% +3)

Continuity

Range	Resolution	Accuracy	Burden Voltage (Typ)
400.0Ω	0.1Ω	Beeper on @ 30Ω for short of 1 ms or longer	Open Circuit voltage <1.5V

Diode Test

Range	Resolution	Accuracy	Burden Voltage (Typ)
2.500V	0.001V	±2% typ	Open circuit voltage <3.3V

AC and DC Current

Range	Resolution	Accuracy	Burden Voltage (typ)
AC (45 Hz to 1 kHz)			
10.00A*	0.01A	±(2.5% +2)	0.03 V/A
DC			
4.000A	0.001A	±(1.0%+5)	0.03 V/A
10.00A*	0.01A	±(1.0%+2)	0.03 V/A

**10A continuous, Lo A for 30 seconds maximum*

Frequency, RPM, Duty Cycle and Temperature

Function	Range	Resolution	Accuracy
Frequency	99.99	0.01 Hz	±(0.01% +2)
(1 Hz to 20 kHz)	999.9	0.1 Hz	±(0.01% +2)
	9.999 kHz	0.001 kHz	±(0.01% +2)
	20.00 kHz	0.01 kHz	±(0.01% +2)
(107V-Hz max)	>20.00 kHz to 99.99 kHz	0.01 kHz	Usable
	500.0 kHz	0.1 kHz	Usable
RPM 1	60-7,000 RPM (usable to 9,999)	1 RPM	±(0.2% + 2) RPM
RPM 2	120-7,000 RPM (usable to 9,999)	1 RPM	±(0.2% + 2) RPM
Dwell Angle	0-120	1 degree	±2 degrees
Duty Cycle	0.0% to 99.9% (1Hz to 20 kHz, pulse width >5 µs)	0.1%	±(0.2%, per kHz + 0.1%) (for rise time <1 µs)
Temperature*	-40 to +999°C @ >20°C ambient, to +980°C below 20°C ambient	1 degree	±(0.3% +6°C) @ -40 to -20°C ±(0.3% +4°C) @ -20 to 0°C ±(0.3% +3°C) @ 0 to 170°C ±(0.3% +5°C) @ 170 to 260°C ±(0.3% +6°C) @ 260 to 700°C ±(0.3% +7°C) @ 700 to 999°C

** When measuring temperature, the accuracy of the system is the combined accuracy of the meter and the thermocouple.*

Frequency Counter Sensitivity and Trigger Level

Input Range	Minimum Sensitivity (RMS Sine Wave)		Approx Trigger Level (DC Volts Function)
	1 Hz to 5 Hz	5 Hz to 20 kHz	
400 mV dc	–	–	400 mV
4000 mV dc	–	–	400 mV
4V	0.7V	0.3V	1.7V
40V	7V	3V	4V
400V	70V	30V	40V
500V	500V	300V (≤14 kHz)	400V

General Specifications

Maximum Voltage Between any Terminal and Earth Ground: 500V dc, or ac rms (sine)
Fuse Protection: 15A 600V FAST Fuse

Display

Digital: 4000 counts, updates 4/s
Bar Graph: 64 segments, update rate 40/s
Frequency: 9,999 counts, updates 3/s

Min/Max Recording

Accuracy: Specified accuracy of measurement function ±16 digits for changes >200 ms in duration ±52 digits in 400Ω)
Nominal Response Time: (5 to 100% of range) 100 ms to 80%

Operating Temperature: 0°C to 55° (32°F to 131°F)
Storage Temperature: -40°C to 60°C (40°F to 140°F)
Temperature Coefficient: 0.1 x (specified accuracy) per °C ambient (<18°C or >28°C). When measuring temperature, 0.04% + 0.1°C per °C
Relative Humidity: 0% to 95%, to 30°C (86°F); 0% to 75%, to 40°C (104°F); 0% to 45%, to 55°C (131°F)
Battery Type: 9V, NEDA 1604 or 6F22 or 006P
Battery Life: Alkaline 500 hrs (typical); Carbon-Zinc 300 hrs (typical)
Continuity Beeper: 4096 Hz
Shock, Vibration: Per MIL-T28800 for a Style D, Class 3 instrument
Safety: Designed to Protection Class II of UL 1244, ANSI/ISA-S82, CSA C22.2 No 231, IEC 348, IEC 1010 overvoltage category II
Safety Approvals: CSA certified. TUV Product Service licensed.
EMI Regulation: Complies with FCC Part 15, Class B, VDE 0871B, Vfg. 243-1991

Inductive Pickup (RPM 80)

Input: Magnetic field from sparkplug
Output: Pulse to trigger Fluke 78

Thermocouple (Fluke 80PK-1)

Type: K (Chromel vs Alumel). Not suitable for immersion in liquid.
Accuracy: ±1.1°C (2°F) between 0°C to 260°C (32°F - 500°F). Typically within 1.1°C (2°F) of NBS tables for temperatures between -40°C (-40°F) to 0°C (32°F)

Temperature Range: -40°C to 260°C. (-40°F to 500°F). Above 260°C (500°F), toxic gas might be emitted.

Note: The temperature range is primarily a function of the thermal limitations of the thermocouple's insulation

Size: 2.8 cm H x 7.5 cm W x 16.6 cm L (1.12 in H x 2.95 in W x 6.55 in L)
Weight: 0.34 kg (12 oz)

Ordering Information

Model

Fluke 78 Automotive Meter

Included with Instrument
Holster with Flex-Stand™, 9V Battery (installed), TL75 Test Leads, AC70 alligator clips, 80PK-1 Bead Thermocouple Probe, 80AK Thermocouple Adapter, User's manual and Quick Reference Guide.

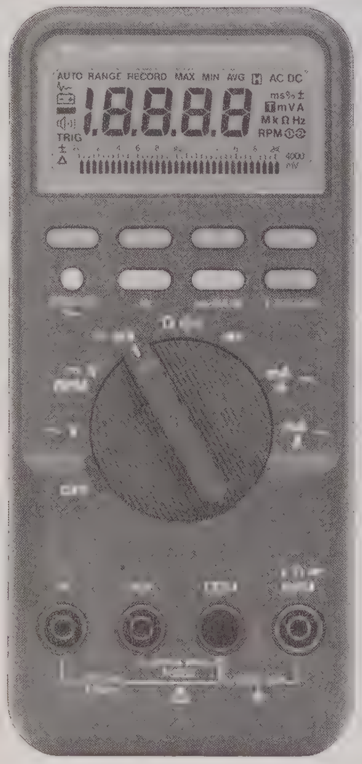
Accessories (Also see Section 7)
AC70 Alligator Clips
C70Y Replacement Yellow Holster
TL75 Test Leads
RPM 80 Inductive Pickup
80i-1010 DC/AC Clamp-on Current Probe
80AK Thermocouple Adapter
80PK-1 Bead Thermocouple Probe
PV500 Digital Pressure-Vacuum Module

Manuals
Fluke 78 User*
Fluke 78 Reference Card*
Fluke 78 Service

**No charge with purchase of unit*

Factory Warranty
Three-year product warranty.

88



Fluke 88

The Fluke 88 automotive meter is designed with the needs of automotive techs in mind. This meter provides troubleshooting solutions to even the most difficult driveability problems encountered with today's complex automotive electronic systems.

The durable construction of the Fluke 88 ensure reliability and optimal performance in the harsh environment of the automotive shop.

Inductive RPM Pickup

This converts the magnetic field generated by the current in the spark plug wire into a pulse that triggers the meter's RPM measurement, allowing for more convenient and accurate readings of both conventional and distributorless (DIS) ignitions.

Duty Cycle

Allowing easy measurement of duty cycle on-times for; fuel injectors, mixture control solenoids, and idle air controls.

Smoothing™ – this feature assures stable readings from varying signals (such as RPM) by providing a digital display of the average of the last eight measurements and a simultaneous analog display of the actual measurements.

Backlit Display – a user friendly feature that allows for easy reading in dark work areas.

Lo-Ohms – Lo-Ohms measures resistance as low as 0.01 ohms, and is used to locate bad grounds on regulators, relay and ignition contacts, magnetic pickups, and coils.

Recording Functions

Min/Max – minimum and maximum measurements (including voltage, current, and temperature with 80TK or 80T-150U temperature modules) are stored and an average of all measurements is maintained until the meter is turned off or the user exits Min/Max recording.

Zero – this displays the difference between the currently measured value and a previously stored value, allowing technicians to instantly compare the two readings. Low resistance measurements are made more accurate because test lead resistance can be canceled out.

Touch Hold® – captures and holds a measurement for later viewing. Automatically updates with each new measurement. Convenient for taking remote measurements under the hood, in the trunk, under the dash, and other hard to reach areas.

Rugged, Sealed Construction

Splash proof, dust proof, and impact resistant case provides protection for years of use under the harshest shop conditions. The yellow color of the protective holster makes it easy to find under the hood.

Fluke 88 Multimeter for Automotive Electronics

- Accurate volts dc and ac, amps dc and ac, and resistance
- Inductive RPM pickup for both conventional and distributorless ignitions
- Frequency measurements with adjustable trigger point
- Duty Cycle for injector measurements
- Audible indicator for diode and continuity tests
- Millisecond pulse width displays readings between 0.002 and 1999.9 milliseconds
- Accurate digital readout (4000 count 3½ digit display) and precision analog display
- 10 Megohm impedance protects sensitive computer circuitry
- Three year warranty
- Autoranging instantly selects the most appropriate range for readings, Range Hold allows for overriding
- Change Alert™ audibly indicates a change in voltage or current reading
- Input Alert™ audibly warns of incorrect input jack connections

Specifications

Technical Specifications

Accuracy is given as ± ([% of reading] + [number of least significant digits]) at 18°C to 28°C with relative humidity up to 90%, for a period of one year after calibration. In the 4½ digit mode, multiply the number of least significant digits (counts) by 10.

DC Volts

Range	Resolution	Accuracy
4.000V	0.001V	±(0.15%+2)
40.00V	0.01V	±(0.15%+2)
400.0V	0.1V	±(0.15%+2)
1000V	1V	±(0.3%+2)

DC Millivolts

Range	Resolution	Accuracy
400.0 mV	0.1 mV	±(0.15%+2)

AC Volts

Range	Resolution	Accuracy (45 Hz - 5 kHz)
400.0 mV	0.1 mV	±(1.5%+10)
4.000V	0.001V	±(1.5%+5)
40.00V	0.01V	±(1.5%+5)
400.0V	0.1V	±(1.5%+5)
1000V	1V	±(2.5%+5)

Conversion Type: AC coupled, average sensing, calibrated to read rms value of sine wave
Input Impedance: 10 MΩ (nominal), <100 pF
DC V Normal Rejection Ratio: >60 dB @ 50 Hz or 60 Hz
DC V Common Mode Rejection Ratio: >120 dB @ dc, 50 Hz or 60 Hz
AC V Common Mode Rejection Ratio: >60 dB, dc to 60 Hz
Overload Protection: 1000V rms

88

Resistance

Range	Resolution	Accuracy
400.0Ω	0.1Ω*	±(0.2%+2)
4.000 kΩ	0.001 kΩ	±(0.2%+2)
40.00 kΩ	0.01 kΩ	±(0.2%+2)
400.0 kΩ	0.1 kΩ	±(0.2%+2)
4.000 MΩ	0.001 MΩ	±(0.2%+2)
40.00 MΩ	0.01 MΩ	±(1%+3)
400.0 MΩ**	0.1 MΩ	±(1%+20)

**In Lo-Ohms/High Resolution Mode, increases to 0.01Ω.*
***These ranges can be selected only in Manual Range.*

Diode Test

Range	Resolution	Accuracy
3.000V	0.001V	±(2%+2)

mA/A DC

Range	Resolution	Accuracy	Burden Voltage
40.00 mA	0.01 mA	±(0.8%+2)	1.5 mV/mA
400.0 mA	0.1 mA	±(0.8%+2)	1.5 mV/mA
4000 mA	1 mA	(0.8%+2)	0.03 V/A
10.00A*	0.01A	±(1.3%+2)	0.03 V/A

**10A continuous, 20A for 30 seconds maximum*

mA/A AC (45 Hz to 2 kHz)

Range	Resolution	Accuracy	Burden Voltage
40.00 mA	0.01 mA	±(3% +10)	1.5 mV/mA
400.0 mA	0.1 mA	±(3% +5)	1.5 mV/mA
4000 mA	1 mA	±(1.5% +5)	0.03 V/A
10.00A*	0.01A	±(1.5% +5)	0.03 V/A

**10A continuous, 20A for 30 seconds maximum*

AC Conversion: Same as voltage

Min Max Recording

Nominal Response	Accuracy
100 ms to 80%	Specified accuracy ±12 digits for changes >200 ms in duration
1 sec	Same as specified accuracy for changes >2 seconds in duration

General Specifications

Maximum Voltage Between any Terminal and Earth Ground: 1000V
Fuse Protection: mA, 1A 600V fast fuse; A, 15A 600V fast fuse

Display (LCD)

Digital
Counts: 4,000; 19,999 in high resolution, 4½-digit mode only.
Update Rates: 1/sec in high resolution, 4½-digit mode only. 3/sec in RPM, frequency, duty cycle, and pulse width. 4/sec in all other functions and ranges.

Frequency, RPM, Duty Cycle, and Pulse Width

Function	Range	Resolution	Accuracy	Pulse Width Range (ms)#	Resolution (ms)
Frequency* (0.5 Hz to 200 kHz, Pulse Width >2 µs)	199.99	0.01 Hz	±(0.01% +1)	1999.9	0.1
	1999.9	0.1 Hz	±(0.01% +1)	5.00	0.01
	19.999 kHz	0.001 kHz	±(0.01% +1)	0.500	0.001
	199.99 kHz	0.01 kHz	±(0.01% +1)	0.0500	0.0001
	>200 kHz	0.1 kHz	Unspecified		
RPM 1	30-9,000	1 RPM	±2 RPM		
RPM 2	60-12,000	1 RPM	±2 RPM		
%Duty Cycle**	0.0-99.9% (0.5 Hz to 200 kHz, Pulse Width >2 µs)				
Pulse Width**	0.002-1999.9 ms (0.5 Hz to 200 kHz, Pulse Width >2 µs)				

#Pulse Width range is determined by the frequency of the signal
**Frequency measurements can be made on voltage or current inputs. The current inputs are always dc-coupled.*
***For rise times >1 µs. Duty Cycle accuracy: within ±(0.2% per kHz + 0.1%). Pulse Width accuracy: ±(0.002 ms + 1 digit).*

Counter Sensitivity and Trigger Level

Input Range*	Minimum Sensitivity @ 0.5 Hz - 200 kHz (RMS Sine Wave)	Approximate Trigger Level (DC Voltage Function)
400 mV dc	70 mV (to 400 Hz)	40 mV
400 mV ac	150 mV	–
4V	0.7V	1.7V
40V	7V	4V
400V	70V (≤140 kHz)	40V
1000	700V (≤14 kHz)	400V

**Maximum input for specified accuracy = 10 x range or 1000V*

Analog: 2 x 32 segments
Update Rate: 40/sec

Frequency and RPM
Counts: 19,999
Update Rate: 3/sec @ >10 Hz

Backlight: Backlight turns on for 68 seconds, then turns off automatically if not turned off by user
Meter Operating Temperature: -20°C to 55°C
Meter Storage Temperature: -40°C to 60°C
Temperature Coefficient: 0.05 x (Specified Accuracy)/°C (<18 or >28°C)
Relative Humidity: 0% to 90% (0 to 35°C); 0% to 70% (35°C to 55°C)

Inductive Pickup
Input: Magnetic field from spark plug
Output: Pulse to trigger
Maximum RPM: 12,000

Safety
Meter: Designed to protection Class II per IEC 348, CSA C22.2 No. 231, ISA-S82, and UL 1244
Pickup: Specified for spark plug wire use only

Battery Type: 9V, NEDA 1604 or 6F22 or 006P
Battery Life: 500 hours typical with alkaline
Shock & Vibration: Per MIL-T-28800 for a Class 2 instrument

Size: 3.1 cm H x 8.6 cm W x 18.6 cm L (1.25 in H x 3.41 in W x 7.35 in L); with holster & Flex-Stand: 5.2 cm H x 9.8 cm W x 20.1 cm L (2.06 in H x 3.86 in W x 7.93 in L)
Weight: 355g (12.5 oz); with holster & Flex-Stand: 624g (22.0 oz)

Ordering Information

Model

Fluke 88 Automotive Multimeter

Included with Instrument
Holster with Flex-Stand™, 9V battery (installed), RPM80 inductive pick up, carrying case, user's manual, quick reference guide, TL24 heat resistant test leads, TP20 industrial probes, and AC85 alligator clips.

Accessories (Also see Section 7)
AC20 Industrial Test Clips
AC85 Large Jaw Alligator Clips
AC89 Insulation Piercing Clip
C81Y Replacement Yellow Holster
TL20 Industrial Test Lead Set
TL24 Flexible Test Leads
TL26 5-Way Multipoint Test Lead Set
TP20 Industrial Test Probes
RPM80 Inductive RPM Pickup
80i-410 Clamp-on DC/AC Current Probe
80i-1010 Clamp-on DC/AC Current Probe
80PK-2A Immersion Temperature Probe
80PK-3A Surface Temperature Probe
80PK-4A Air Temperature Probe
80TK Thermocouple Module

Manuals
Fluke 88 User
Fluke 88 Reference Card
Fluke 88 Service

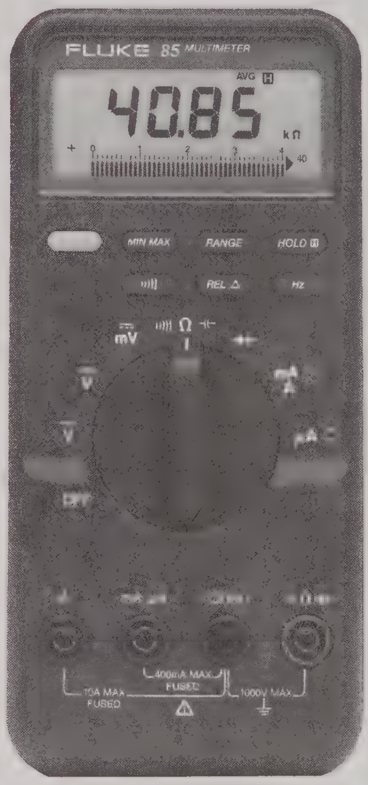
Factory Warranty
Three-year product warranty.

83, 85 & 87

Available through Distributors

LISTED UL 1244

Fluke 83



LISTED UL 1244

Fluke 85

LISTED UL 1244

Fluke 87

Fluke 83 Analog/Digital
$3^3/_4$ digit, 4000 counts
0.3% basic dc accuracy
43 segment analog bargraph
Frequency & duty cycle
Capacitance
Touch Hold® & Relative
3 year warranty

Fluke 85 Analog/Digital
$3^3/_4$ digit, 4000 counts
0.1% basic dc accuracy
43 segment analog bargraph
Frequency & duty cycle
Capacitance
Touch Hold® & Relative
3 year warranty

Fluke 87 Analog/Digital
$3^3/_4$ digit, 4000 counts
0.1% basic dc accuracy
Analog pointer
Frequency & duty cycle
Capacitance
Touch Hold® & Relative
3 year warranty
True-rms ac voltage & current
1 ms peak MIN MAX
$4^1/_2$ digit mode
Back lit display

83, 85 & 87

The Fluke 80 Series (83, 85, and 87) is a family of versatile analog/digital multimeters with an impressive range of capabilities, including frequency, duty cycle and capacitance measurement.

Designed for electronic as well as industrial applications, the 80 Series' durable construction and unique safety features ensure reliability and optimal performance in a variety of environmental settings.

MIN/MAX Average Recording Mode with Min Max Alert™

Stores the highest, lowest, and average of all readings, allowing you to monitor a signal for seconds or days. Selectable response times allow you to specify the time required to sense changes. Min Max Alert gives an audible tone for readings above or below previous minimums or maximums.

Frequency, Duty Cycle and Capacitance Measurements

Fluke 80 Series meters have a counter for frequency measurements from 0.5 Hz to 200 kHz, and duty cycle measurements from 0.1% to 99.9% of cycle. All three meters measure capacitance from 10 pF to 5 µF. Larger value capacitors may be measured using the analog display in the resistance mode.

Input Alert™ and Overload Protection

Input Alert provides an audible warning when current jacks are used and a non-current function is selected. This reduces the risk of damage to the equipment being tested and to the meter. Fluke 80 Series meters also provide 1000 volt input protection in both ohms and diode test.

Fast $3\frac{3}{4}$ Digit, 4000 Count Digital, High Resolution Analog Display

Ensures greater accuracy and resolution. Digital display updates 4 times/second.

For changing or unstable signals, the 87 features a high-resolution analog pointer; the 83 and 85 use an analog bargraph. The 83 and 85 also feature Zoom Mode for higher resolution analog readings. Analog displays update 40 times per second.

$4\frac{1}{2}$ Digit Mode, 1 ms Peak Hold, True-rms, Backlit Display (87 only)

The Fluke 87 is a true-rms meter, and offers a $4\frac{1}{2}$ digit, 19,999 count high resolution mode, plus 1 ms peak hold. The backlit display assures readability in poorly lit settings. Light shuts itself off 68 seconds after the button is pressed, prolonging battery life.

Touch Hold and Relative Modes

Touch Hold captures the measurement, beeps and locks it on the digital display until you're ready to view it. It automatically updates with each new measurement.

The Relative Mode remembers a reading and shows the change (difference) between it and any readings that follow.

Rugged, Sealed Construction

Splash and dust proof case and a specially designed protective holster protects the meter even under harsh operating conditions. All units are sealed and EMI shielded.

Standard Equipment

Every meter comes packaged with a yellow protective holster complete with a Flex-Stand,™ safety-designed test leads, 9V battery (installed), manual and operator guide.

Specifications

Technical Specifications

Basic electrical specifications are given as ± ([% of reading] + [number of least significant digits]) for the temperature range of 18°C to 28°C and relative humidity less than 90%, for one year after calibration.

DC Voltage

Range	83	85/87
	Accuracy: ±(% of Rdg+Digits)	
400.0 mV, 4.000V, 40.00V, 400.0V, 1000V	0.3% + 1	0.1% + 1

Maximum Resolution: 0.1 mV in 400.0 mV range
Input Impedance: 10 MΩ (nominal), <100 pF
Normal Mode Rejection Ratio: >60 dB @ 50 Hz or 60 Hz
Common Mode Rejection Ratio: >120 dB @ dc, 50 Hz or 60 Hz
Overload Protection: 1000V rms

AC Voltage

Range	83	85	87
50 Hz-60 Hz			
400.0 mV	±(1%+4)	±(0.5%+4)	±(0.7%+4)
4.000V, 40.00V, 400.0V	±(1%+3)	±(0.5%+2)	±(0.7%+2)
1000V	±(1%+3)	±(0.5%+2)	±(0.7%+2)
45 Hz-5 kHz			
400.0 mV	±(1.5%+4)	±(1%+4)	±(1%+4)
4.000V, 40.00V, 400.0V	±(1.5%+3)	±(1%+2)	±(1%+4)
1000V	±(2.5%+3)	±(2%+2)	±(1%+4)*
5 kHz-20 kHz			
400.0 mV	—	±(2%+4)	±(2%+4)*
4.000V, 40.00V, 400.0V	—	±(4%+4)	±(2%+4)*
1000V	—	Unspec'd	Unspec'd

** Add 16 counts below 10% of range*

Maximum Resolution: 0.1 mV in the 400.00 mV range
AC Conversion: Inputs are ac-coupled and calibrated to the rms value of a sine wave input. Fluke 83 and 85 ac conversions are average responding. Fluke 87 ac conversions are true-rms responding and specified from 5% to 100% of range. Fluke 87 input signal crest factor can be up to 3 at full scale, 6 at half scale. For non-sinusoidal waveforms add ±(2% rdg + 2% Fs) typical, for a crest factor up to 3.
Input Impedance: 10 MΩ (nominal), 100 pF
Common Mode Rejection Ratio: >60 dB @ dc to 60 Hz
Overload Protection: 1000V rms
AC V Common Mode Rejection Ratio: >60 dB, dc to 60 Hz

DC and AC Current: (45 Hz to 2 kHz)

Range	83	85	87	Burden Voltage
AC	Accuracy: ±(% of Rdg+Digits)			
400.0 µA, 4000 µA	1.2%+2	0.6%+2	1.0%+2	100 µV/µA
40.00 mA, 400.0 mA	1.2%+2	0.6%+2	1.0%+2	1.5 mV/mA
4000 mA, 10.00A*	1.2%+2	0.6%+2	1.0%+2	0.03 V/A
DC	Accuracy: ±(% of Rdg+Digits)			
400.0 µA, 4000 µA	0.4%+2	0.2%+2	0.2%+2	100 µV/µA
40.00 mA, 400.0 mA	0.4%+2	0.2%+2	0.2%+2	1.5 mV/mA
4000 mA, 10.00A*	0.4%+2	0.2%+2	0.2%+2	0.03 V/A

**10A continuous, 20A for 30 seconds maximum*

Maximum Resolution: 0.1 µA in the 400 µA range
Overload Protection: µA/mA Ranges: 1A 600V FAST fuse; Amp Range: 15A 600V FAST fuse
AC Conversion: Same as voltage

83, 85 & 87

Ohms

Range	83	85/87
	Accuracy: ±(% of Rdg + Digits)	
400.0Ω, 4.000 kΩ, 40.00 kΩ 400.0 kΩ, 4.000 MΩ	0.4% + 1	0.2% + 1
40.00 MΩ	1.0% + 3	1.0% + 3
40.00 nS	1.0% + 10	1.0% + 10

Maximum Resolution: 0.1Ω in the 400.0Ω range
Overload Protection: 1000V rms for circuits <0.3A short circuit, 660V for high energy circuits
Full Scale Voltage: <450 mV dc up to 4.0 MΩ <1.3V dc for 40 MΩ or nS
Open Circuit Voltage: <1.3V

Frequency

0.5 Hz to 200 kHz, pulse width >2 µS

Range	Accuracy: ±(% of Rdg + Digits)
199.99 Hz, 1999.9 Hz 19.999 kHz, 199.99 kHz	0.005% + 1
>200 kHz	Unspecified

Maximum Resolution: 0.01 Hz on the 199.99 Hz range
Duty Cycle: 0.1% to 99.9%
Accuracy: Within ±(0.05% per Hz + 0.1%) of full scale for a 5V logic family input on the 4V dc range; within ±((0.06 x voltage range/input range) x 100%) of full scale for sine wave inputs on ac voltage ranges

Capacitance

Range	Accuracy: ±(% of Rdg + Digits)*
5.00 nF	1.0% + 35**
0.0500 µF, 0.500 µF 5.00 µF	1.0% + 2

** Accuracy with film capacitors or better*
***±(1.0% + 2) if Relative mode is used for zero residual*

Maximum Resolution: 0.01 nF on the 5.00 nF range

Diode Test and Continuity

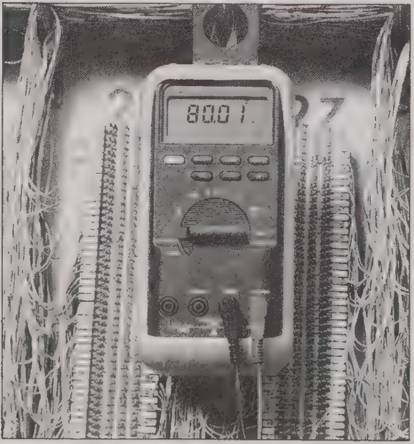
Diode Test Indication: Display voltage drop; 0.8 mA nominal test current at 0.6V; 3.0V full scale, accuracy: ±(2.0% + 1)
Continuity Indication: Continuous audible tone for test resistance below 20Ω
Open Circuit Voltage: <3.9V dc
Overload Protection: 1000V rms for circuits <0.3A short circuit, 660V for high energy circuits

Display

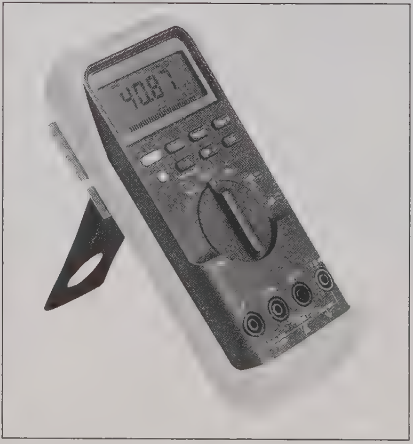
Digital: 4000 counts, updates 4 times per second
Analog: 43 segments, updates 40 times per second (for 83 and 85); 4 x 32 segments (equivalent to 128), updates 40/sec (for 87)
Frequency: 19,999 counts, updates 3 times per second @ >10 Hz
Annunciators: u, m, n, k, M, V, A, F, S (siemens), Ω (ohms), Hz, AC, DC, MIN, MAX, RECORD, (AUTO autorange), (duty cycle), (hold), (low battery), (audible continuity), (relative)

General Specifications

Maximum Voltage Applied to Any Earth Terminal: 1000V rms
Storage Temperature: - 40°C to 60°C
Operating Temperature: -20°C to 55°C
Temperature Coefficient: 0.05 x (specified accuracy) per °C (for temperatures <18°C or >28°C)
Relative Humidity: 0 to 90% (0 to 35°C) 0 to 70% (35°C to 55°C)
Shock & Vibration: Per MIL-T-28800 for a Class 2 Instrument
Safety: Designed to Class II per IEC 348, ANSI/ISA-S82, UL 1244, and CSA C22.2 No. 231
Power Requirements: Single 9V battery (NEDA 1604 or 6F22 or 006P)
Battery Life: 500 hours typical (alkaline). Battery symbol first displayed when at least 60 hours of battery life remain.
Size: 32 mm H x 87 mm W x 187 mm L (1.25 in H x 3.41 in W x 7.35 in L); with holster and Flex-Stand, 52 mm H x 98 mm W x 201 mm L (2.06 in H x 3.86 in W x 7.93 in L)
Weight: 0.36 kg (12.5 oz); with holster and Flex-Stand 0.62 kg (22.0 oz)



Protective Holster



Flex-Stand

Ordering Information

Models

Fluke 83 Analog/Digital Multimeter
Fluke 85 Analog/Digital Multimeter
Fluke 87 Analog/Digital Multimeter

Included with Instrument

Three-year product warranty, one-year on calibration cycle, yellow protective holster complete with a Flex-Stand, TL75 safety-designed test leads, 9V battery (installed), operator's manual and guide.

Accessories (Also see Section 7)

C25	Ruggedized Soft Case
C81G	Optional Grey Holster
C81Y	Replacement Yellow Holster
C100	Universal Carrying Case
TL20	Industrial Test Lead Set
TL75	Hard Point Test Lead Set
Y8132	Replacement Test Lead Set
Y8134	Universal Test Lead Kit
Y8140	Needle Point Test Lead Set
80TK	Thermocouple Module
80T-150U	Universal Temperature Probe
Y8100	Clamp-on DC/AC Current Probe
Y8101	Clamp-on AC Current Probe
80i-400	Clamp-on AC Current Probe
80i-410	Clamp-on DC/AC Current Probe
80i-600	Clamp-on AC Current Probe
80i-1010	Clamp-on DC/AC Current Probe
80i-kW	Current/Power Probe
80K-6	High Voltage Probe
80K-40	High Voltage Probe
83RF	High Frequency Probe, 100 MHz
85RF	High Frequency Probe, 500 MH

Manuals

83/85 Operator*
83/85 Operator, Multilingual
87 Operator*
80 Series Service

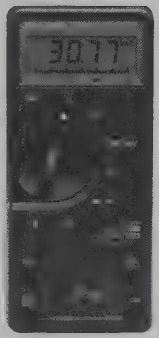
**No charge with purchase of unit*

Factory Warranty

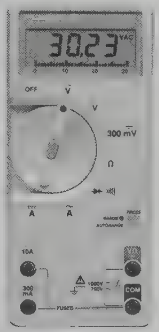
Three-year product warranty.

AVAILABLE THROUGH DISTRIBUTORS

Available through Distributors



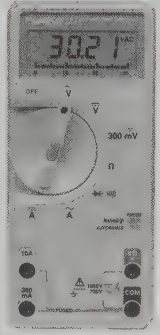
Fluke 77



Fluke 23

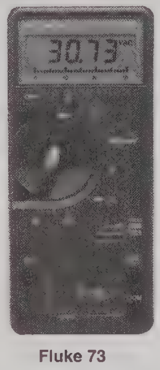
LISTED UL 1244 DVE

Fluke 75



Fluke 21

LISTED UL 1244 DVE



Fluke 73

Fluke 70

LISTED UL 1244 DVE

Fluke 77 & 23

- 3200 count digital display
- 31 segment analog bar graph
- 0.3% basic dc volts accuracy
- 2.0% basic ac volts accuracy
- 1.5% basic dc current accuracy (32 mA to 10A)
- 0.5% basic resistance accuracy
- 2000 hour battery life (alkaline)
- Holster/Flex-Stand™

Fluke 75 & 21

- 3200 count digital display
- 31 segment analog bar graph
- 0.4% basic dc volts accuracy
- 2.0% basic ac volts accuracy
- 1.5% basic dc current accuracy (32 mA to 10A)
- 0.5% basic resistance accuracy
- 2000 hour battery life (alkaline)

Fluke 73

- 3200 count digital display
- 31 segment analog bar graph
- 0.4% basic dc volts accuracy
- 2.0% basic ac volts accuracy
- 1.5% basic dc current accuracy (10A input only)
- 0.5% basic resistance accuracy
- 2000 hour battery life (alkaline)

Fluke 70

- 3200 count digital display
- 31 segment analog bar graph
- 0.5% basic dc volts accuracy
- 2.0% basic ac volts accuracy
- 0.5% basic resistance accuracy
- 2000 hour battery life (alkaline)

Features on all Models

- Automatic Touch Hold®
- Diode Test
- Audible continuity beeper
- Autoranging with manual ranging
- TL75 test leads with Hard Points™
- Sleep mode
- 3 year warranty
- 79/77/75/73/70 for measurements to 4800 V-A
- 29/23/21 for higher energy measurements

The Fluke 70 Series multimeters were first introduced in 1983 with three models, 73, 75 and 77. The Series was later expanded with the addition of the Industrial Models, 21 and 23. This Series has become a Classic. We have improved on the existing models and added three models, the 70, 29/79.

Autoranging

With autoranging, you choose the function you want and the meter automatically selects the range with the greatest accuracy and resolution. Symbols on the liquid crystal display remind you what is being measured and the range of measurement.

70 Series II

Range Hold

Since repetitive go-no-go tests and peaking/dipping adjustments are more easily done using one range, the manual range function will prove a real boon to users making these tests frequently. Touching the pushbutton once prevents the meter from changing ranges. Pushing the button again changes the range, and holding the button down for a couple of seconds restores the "Autorange" function.

Audible Tones

A continuous audible tone provides a fast check for continuity of current paths having 150 ohms or less. A brief tone indicates a voltage drop of about 0.6 volts, the normal forward bias for semiconductor devices passing about 500 microamps.

Touch Hold®

Touch Hold captures a reading and displays it from memory even after the probe has been removed from the circuit. As soon as the reading stabilizes, the meter makes a distinctive audible chirp and automatically holds the reading. Touch Hold reduces the chance of circuit damage when a probe slips and contacts two points at once because you can concentrate on touching the right test point and nothing else. Touch Hold reduces the risk of electrical shock and also gives the user time to log the reading if needed or refer back to the reading before the next measurement.

Multimeter Holster (23, 77)

Our multipurpose holster is made of a tough resilient yellow plastic that snaps over the instrument, protecting it from even the most severe shock. The patented Flex-Stand makes the holster exceptionally versatile. It can be used to stand the meter on a bench, or it can be bent around a pipe or fastened to a tool belt.

Digital/Analog

The Model 21, 23, 70, 73, 75, and 77 provide a 3200 count digital display that gives extended resolution and a 31 segment bar graph that reacts 10 times faster than the numerical display, allowing you to make peaking and dipping adjustments easier than with digital-only DMMs.

Specifications

Technical Specifications

for the 21, 23, 70, 73, 75 and 77

Specifications apply to all models unless otherwise stated. Accuracy is specified as ±([% of reading] + [number of least significant digits]) at 18°C to 28°C (64°F to 82°F) with relative humidity to 90%, for a period of one year after calibration.

Display: 3200 counts, updates 2.5/sec
Analog: 31 segments, update rate 25/sec

Voltage

DC V - Range	70	73/75/21	77/23
320 mV	±(0.5% + 1)	±(0.4% + 1)	±(0.3% + 1)
3.200V 32.00V 320.0V	±(0.5% + 1)	±(0.4% + 1)	±(0.3% + 1)
1000V	±(0.6% + 1)	±(0.4% + 1)	±(0.4% + 1)
AC V - Range	**70/73/75/77/21/23**		
45-500 Hz 3.2V **45-1 kHz** 32.00V 320.0V 750V	±(2% + 2)		

AC Conversion: AC-coupled, average responding, and calibrated to the rms value of a sine wave input
Best Resolution: 0.1 mV in 320 mV range
Input Impedance: 10 MΩ nominal, <50 pF
DC V Normal Mode Rejection: >60 dB @ 50 Hz or 60 Hz
DC V Common Mode Rejection Ratio: >120 dB @ dc, 50 Hz or 60 Hz
AC V Common Mode Rejection Ratio: >60 dB, dc to 60 Hz
Overload Protection: 1000V dc (500V dc, 500V ac {sine} on mV range), 750V ac rms (sine)

Current*

DC - Range	73	75/77/21/23
32.00 mA, 320.0 mA		±(1.5% + 2)
10.00A**	±(1.5% + 2)	±(1.5% + 2)
AC - Range		
45 Hz to 1 kHz 32.00 mA, 320.0 mA		±(2.5% + 2)
45 Hz to 1 kHz 10.00A**	±(2.5% + 2)	±(2.5% + 2)

**Current function not available on Fluke 70*
***10A continuous, 20A for 30 seconds maximum*

AC Conversion: Same as voltage
Best Resolution: 0.01 mA in 32 mA range (75/77/21/23); 0.01A in 10A range (73)
Burden Voltage: 6 mV/mA for mA input (75/77/21/23), 50 mV/A for A input (73/75/77/21/23)
Input Protection: mA – 630 mA, 250V FAST fuse (75/77/21/23); A – 15A, 600V FAST fuse (all models except 70)

Ohms and Diode Test

Range	70/73/75/77/21/23
320.0Ω	±(0.5% + 2)
3200Ω, 32.00 kΩ 320.0 kΩ, 3.200 MΩ	±(0.5% + 1)
32.00 MΩ	±(2% + 1)

Best Resolution: 0.1Ω on 320.0Ω range
Diode Test: To 2.0V
Continuity: Continuous tone (4096 Hz) for resistance <150Ω
Overload Protection: 500V dc or rms (sine)
Open Circuit Voltage: <3.1V dc (diode test); <3.1V dc (Ω)
Full Scale Voltage (Ω): <440 mV dc to 3.2 MΩ, <1.4V dc for 32 MΩ
Short Circuit Current: <500 µA (Ω); 700 µA (x)

Environmental Data

Operating Temperature: 0°C to 50°C
Storage Temperature: -40°C to 60°C
Temperature Coefficient: 0.1 x (specified accuracy)/°C (<18°C or >28°C)
Relative Humidity: 0% to 90% (0°C to 35°C); 0% to 70% (35°C to 50°C)
Shock, Vibration: Per MIL-T-28800 for a Style B, Class 2 Instrument

General Specifications

Maximum Voltage to Earth: 1000V dc, 750V ac rms (sine)
Battery Type: 9V, NEDA 1604 or 6F22 or 006P
Battery Life: 2000 hours typical (alkaline)
Safety: Designed to Protection Class II per IEC 348, ANSI/ISA-S82, UL 1244, CSA C22.2 No. 231, and IEC 1010 overvoltage category II.
Sleep Mode: After one hour of inactivity (20 minutes in diode test)
Automatic Touch Hold: Automatically holds each new reading; beeps when reading is stable; automatically resets between readings
Warranty: Three years parts and labor
Size: 166 mm L x 75 mm W x 28 mm H (6.55 in L x 2.95 in W x 1.12 in H)
Weight: 0.34 kg (12 oz) without holster

Ordering Information

See page 122.

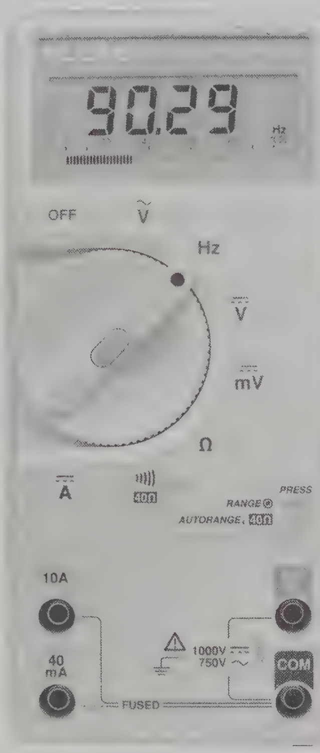
70 Series II

Available through Distributors

90.79
Hz
40Ω
40Ω
COM

LISTED
UL
1244

Fluke 79



LISTED
UL
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Fluke 29

Fluke 79 & 29
Frequency counter
Capacitance
Low-ohms range with zero calibration
Smoothing™
4000 count digital display (9999 count for frequency, capacitance)
63 segment analog bar graph
0.3% basic dc volts accuracy
1.0% basic ac volts accuracy
1.5% basic dc current accuracy (4 mA to 10A)
0.4% basic resistance accuracy
Holster/Flex-Stand™
700 hour battery life (alkaline)

29, 79

The addition of the 29 and 79 to the 70 Series family has brought advanced measurement capability and state-of-the-art analog and digital performance to this popular DMM family. By using the proprietary Fluke integrated circuit technology, these top-of-the-line meters have added significant features with very little added cost.

63 Segment Analog Bar-Graph

Updates at a rate of 40 times per second. The speed and resolution of the bar-graph give a true simulation of an analog meter needed for detecting peaks, nulling and trending.

Capacitance

Using six ranges, the 29/79 can measure capacitance from 10 pF to 9,999 µF (specified accuracy to 999.9 µFd, 9999.9 µFd has typical specification) and replace that dedicated capacitance meter in the tool box.

Frequency

A built-in frequency counter can measure from 1 Hz to over 20 kHz. And while the frequency is being displayed on the digital display, the analog bar graph is displaying the ac voltage level.

Lo-Ohms

A 40 ohm range with Fluke's proprietary Zero Calibration technique – which compensates for test leads resistance – offers 0.01 ohm resolution with high noise rejection.

Smoothing

The Smoothing mode obtains a more stable reading from an unstable input by displaying a running average of the readings.

Holster

Like the Fluke 23/77, the 29/79 includes the yellow protective holster, C70Y.

Specifications

Technical Specifications

for 29/79

Accuracy is specified as ±([% of reading] + [number of least significant digits]) at 18°C to 28°C (64°F to 82°F) with relative humidity to 90%, for a period of one year after calibration.

Display: 4000 counts, updates 4/sec {9999 counts for frequency, capacitance and Lo-ohms}
Analog: 63 segments, update rate 40/sec

70 Series II

Voltage

DC V - Range	29/79
40.00 mV	±(0.3% + 5)
400.0 mV, 4.000V, 40.00V, 400.0V	±(0.3% + 1)
1000V	±(0.3% + 1)
AC V - Range	
45 Hz to 1 kHz 400.0 mV	±(1.9% + 4)
45 Hz to 1 kHz 4.000V	±(1.9% + 2)
45 Hz to 1 kHz 40.00V, 400.0V 750.0V	±(1.0% + 2)
to 20 kHz All ranges	±1.5 dB typical

AC Conversion: AC-coupled, average responding, and calibrated to the rms value of a sine wave input
Best Resolution: 0.01 mV dc in 40 mV range
Input Impedance: 10 MΩ nominal, <100 pF
DC V Normal Mode Rejection: >60 dB @ 50 Hz or 60 Hz
DC V Common Mode Rejection Ratio: >120 dB @ dc, 50 Hz or 60 Hz
AC V Common Mode Rejection Ratio: >60 dB, dc to 60 Hz
Overload Protection: 1000V dc, 750V ac rms (sine)

Current

DC - Range	29/79
4.000 mA, 4.000A	±(0.5% + 5)
40.00 mA, 10.00A*	±(0.5% + 2)
AC - Range	
45 Hz to 1 kHz 4.000 mA, 4.000A	±(1.5% + 4)
45 Hz to 1 kHz 40.00 mA, 10.00A*	±(1.5% + 2)

**10A continuous, 20A for 30 seconds maximum*

AC Conversion: Same as voltage
Best Resolution: 0.001 mA in 4 mA range
Burden Voltage: 11 mV/mA for mA input, 30 mV/A for A input
Input Protection: mA – 1A, 600V FAST fuse; A – 15A, 600V FAST fuse

Ohms and Diode Test

Range	29/79
400.0Ω	±(0.4% + 2)
4.000 kΩ, 40.00 kΩ 400.0 kΩ, 4.000 MΩ	±(0.4% + 1)
40.00 MΩ	±(1% + 3)

Lo-Ohms: 40Ω and 400Ω ranges, 5% typical; 8 kΩ range, 10% typical
Best Resolution: 0.01Ω on 40.00Ω range
Diode Test: Displays voltage drop to 2.45V
Continuity: Continuous tone (4096 Hz) for resistance <30Ω
Overload Protection: 500V dc or rms (sine)
Open Circuit Voltage: <3.1V dc (diode test); <3.1V dc (Ω)
Full Scale Voltage (Ω): <450 mV dc to 4.0 MΩ, <1.3V dc for 40 MΩ
Short Circuit Current: <500 µA (Ω); 800 µA typical (x)

Capacitance

Ranges: 99.99 nF, 999.9 nF, 9.999 µF, 99.99 µF, 999.9 µF, 9999 µF
Best Resolution: 0.01 nF in 99.99 nF range
Accuracy: ±(1.9% + 2) except 9999 µF range, ±10% typical for 9999 µF range, with film capacitor or better and open lead reading subtracted from measurement

Frequency

Ranges: 99.99 Hz, 999.9 Hz, 9.999 kHz, 99.99 kHz, 999.9 kHz
Best Resolution: 0.01 Hz in 99.99 Hz range
Accuracy: ±(0.01% + 1) to 20 kHz, usable above 20 kHz
Sensitivity: 150 mV, 500 Hz to 20 kHz; 500 mV, 1 Hz to 20 kHz

Environmental Data

Operating Temperature: 0°C to 55°C
Storage Temperature: -40°C to 60°C
Temperature Coefficient: 0.1 x (specified accuracy)/°C (<18°C or >28°C)
Relative Humidity: 0% to 90% (0°C to 35°C); 0% to 70% (35°C to 55°C)
Shock, Vibration: Per MIL-T-28800 for a Style B, Class 2 Instrument

General Specifications

Maximum Voltage to Earth: 1000V dc, 750V ac rms (sine)
Battery Type: 9V, NEDA 1604 or 6F22 or 006P
Battery Life: 700 hours typical (alkaline)
Safety: Designed to Protection Class II per IEC 348, ANSI/ISA-S82, UL 1244, CSA C22.2 No. 231, and IEC 1010 overvoltage category II.
Sleep Mode: After one hour of inactivity (20 minutes in diode test)
Automatic Touch Hold: Automatically holds each new reading; beeps when reading is stable; automatically resets between readings
Size: 28 mm H x 75 mm W x 166 mm L (1.12 in H x 2.95 in W x 6.55 in L)
Weight: 0.34 kg (12 oz) without holster

Ordering Information

Models

Fluke 70-2 Multimeter
Fluke 73-2 Multimeter
Fluke 75-2 Multimeter
Fluke 77-2 Multimeter with Holster
Fluke 79-2 Multimeter with Holster
Fluke 21-2 Multimeter
Fluke 23-2 Multimeter with Holster
Fluke 29-2 Multimeter with Holster

Included with Instruments

Three-year product warranty, safety-designed TL75 right-angle test leads, 9V battery (installed), operator's manual. Models 77, 79, 23 and 29 also include yellow C70Y Holster with Flex-Stand. C70Y is available as an accessory for Fluke 21.

Accessories (Also see Section 7)
TL20 Industrial Test Lead Set
TL22 Flexible Test Leads
TL24 Flexible Test Leads
TL75 Hard Point Test Leads
TP20 Industrial Test Probes
TP80 Electronic Test Probe
AC20 Industrial Test Clips
AC70 Alligator Clips
AC80 Hook-Style Test Clips
AC83 Pin Grabber Test Clips
C50 Soft Carrying Case
C70G Grey Holster with Flex-Stand
C70Y Yellow Holster with Flex-Stand
C90 Soft Carrying Case
C100 Universal Carrying Case
Y8101* Clamp-on AC Current Probe
80i-400* Clamp-on AC Current Probe
80i-410 AC/DC Clamp-on Current Probe
80i-600* Clamp-on AC Current Probe
80i-1010 Clamp-on DC/AC Current Probe
80T-150U Universal Temperature Probe
80TK Thermocouple Module

**Not compatible with Fluke model 70, limited performance with 73.*

Manuals
70 Series II Operator*
70 Series II Service
79/29 Series II Operator*
79/29 Series II Quick Reference Card*
79/29 Series II Service

**No charge with purchase of unit*

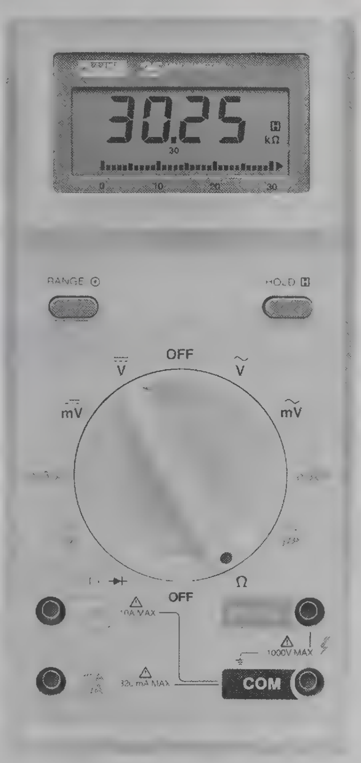
Factory Warranty

Three-year product warranty.

AVAILABLE THROUGH
DISTRIBUTORS

25 & 27

Available through Distributors



Fluke 25

LISTED
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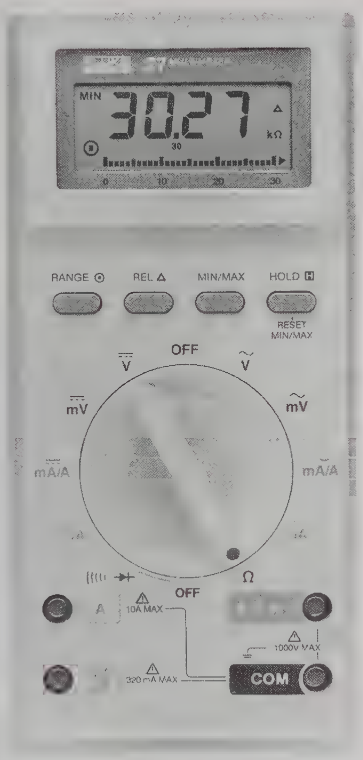
1244

DVE
MSHA
United States Department of Labor
Mine Safety and Health Administration
APPROVAL
2G-3665-0
PERMISSIBLE
MULTIMETER



Fluke 27

LISTED
UL
1244

DVE
MSHA
United States Department of Labor
Mine Safety and Health Administration
APPROVAL
2G-3665-0
PERMISSIBLE
MULTIMETER

Fluke 25 & 27 Analog/Digital & Rugged Multimeters
Analog and digital display - tests changing or stable signals
Easy to use, auto or manual range selection
3-year warranty, 1-year calibration cycle
Rugged "O" ring sealed case withstands harsh environments
Superior EMI shielding
-15° to 55°C operating range
"Min-Max" Mode stores highest & lowest readings (27 only)
"Relative Mode" displays only changes in readings (27 only)

Rugged

Plant maintenance electricians, field service technicians, electrical equipment installers, and outside equipment installers will find these instruments rugged, reliable, and easy to use while providing all the accuracy and features needed for almost any application.

Designed to meet military specification of MIL-STD-28800 for Style A, Class 2 Instruments, the Fluke 25 and 27 Analog/Digital Multimeters perform under the extremes of heat, cold, humidity, shock, electromagnetic interference, vibration, and downright abuse.

The Fluke 25 and 27 are built with cases twice as thick as any other DMM we build. The cases are waterproof to 3 feet of water for one hour, resist many industrial chemicals, and won't sustain a flame when put to the blow torch test.

Safety Protection

Electrical and safety protection exceeds the world's toughest safety standards.

Autoranging

With autoranging, you choose the function you want and the meter automatically selects the range with the greatest accuracy and resolution. Symbols on the liquid crystal display remind you what is being measured and the range of measurement.

Manual Range

Since repetitive go-no-go tests and peaking/dipping adjustments are more easily done using one range, the manual range function will prove a real boon to users making these tests frequently. Touching the pushbutton once prevents the meter from changing ranges. Pushing the button again changes the range, and holding the button down for a couple of seconds restores the "Autorange" function.

Audible Tones

A continuous audible tone provides a fast check for continuity of current paths having 150 ohms or less.

A brief tone indicates a voltage drop of about 0.6 volts, the normal forward bias for semiconductor devices.

Touch Hold®

Touch Hold captures a reading and displays it from memory even after the probe has been removed from the circuit. As soon as the reading stabilizes, the meter makes a distinctive audible chirp and holds the reading. Touch Hold reduces the chance of circuit damage when a probe slips and contacts two points at once because you can concentrate on touching the right test point and nothing else. Touch Hold reduces the risk of electrical shock and also gives the user time to log the reading if needed or refer back to the reading before the next measurement.

Min/Max Mode

The Fluke 27 can be connected to store minimum and maximum values that will be stored in memory for an extended period, such as over a weekend: useful for monitoring in the absence of chart recorders.

25 & 27

Relative Mode

Often a technician will need to know how much one reading differs from another. By taking the first reading as a reference then pressing the "REL" button, the succeeding measurements will display only the deviation from the reference.

Specifications

Technical Specifications

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0 mV	100 µV	0.1% + 1
3.200V	1 mV	
32.00V	10 mV	
320.0V	100 mV	
1000V	1V	

Input Impedance: 10 MΩ in parallel with <100 pF
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB at dc 50 Hz or 60 Hz; ≤1 kΩ unbalance
Overload Protection V: 1000V rms
Overload Protection mV: 500V rms
Response Time: ≤2s to rated accuracy

AC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)		
		40 Hz-2 kHz	2 kHz-10 kHz	10kHz-30 kHz
320.0 mV 3.200V 32.00V 320.0V	100µV 1 mV 10 mV 100 mV	0.5% + 3	2% + 3	4%+10
1000V	1V	1% + 3	3% + 3	Not spec

Input Impedance: 10 MΩ in parallel with <100 pF
Common Mode Noise Rejection: ≥60 dB from dc to 60 Hz; ≤1 kΩ unbalance
Overload Protection V ac: 1000V rms (10^7 volt-hertz max)
Overload Protection mV ac: 500V rms (10^7 volt-hertz max)
Response Time: ≤2s to rated accuracy

DC Current

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Typical Burden Voltage
320.0 µA	0.1 µA	0.75% + 2	0.5 mV/µA
3200 µA	1 µA		0.5 mV/µA
32.00 mA	0.01 mA		5.6 mV/mA
320.0 mA	0.1 mA		5.6 mV/mA
10.00A	0.01A		50 mV/A

Input Protection: µA/mA ranges, 630 mA/250V fuse in series with 3A/600V fuse; 10 amp range, 20A/600V fuse
Response Time: ≤2s to rated accuracy

AC Current

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Typical Burden Voltage
320.0 µA	0.1 µA	1.5% + 2*	0.5 mV/µA
3200 µA	1 µA		0.5 mV/µA
32.00 mA	0.01 mA		5.6 mV/mA
320.0 mA	0.1 mA		5.6 mV/mA
10.00A	0.01A		50 mV/A

**40 to 1000 Hz*

Overload Protection: Same as dc current
Response Time: ≤4s to rated accuracy

Resistance

Range	Resolution	Response Time	Accuracy ±(% of Rdg + Digits)
320.0Ω	0.1Ω	6s	0.3% + 2
3.200 kΩ 32.00 kΩ 320.0 kΩ 3.200 MΩ	1Ω 10Ω 100Ω 1 kΩ	2s	0.2% + 2
32.00 MΩ	10 kΩ	6s	1% + 1

Overload Protection: 500V rms
Open Circuit Test Voltage: <2.8V dc
Full Scale Voltage: Up to 3.2 MΩ <420 mV dc; 32 MΩ <1.3V dc

Conductance

Measures up to 32.00 nS (to 100,000 MΩ) with 0.01 nS resolution accurate to ±1% + 10; full scale voltage <1.3V dc
Response Time: ≤6s to rated accuracy

Diode Test/Continuity Test

Overload Protection	Open Circuit Test Voltage	Typical Test Current	Display Voltage
500V rms	<3.3V dc	0.7 mA	0.0V
		0.5 mA	0.6V
		0.3 mA	1.2V
		0.1 mA	2.0V

General Specifications

MIN/MAX Mode (27 only): Records the digital display readings (updated twice per second)
Display: $3^1/_2$ digits 3200 counts autopolarity, autozero
Common Mode Voltage: 1000V between any terminal and earth ground
Shock, Vibration and Water Resistance: Per MIL-T-28800 Class 2 Style A
Temperature: Storage -55°C to 85°C; Operation -15°C to 55°C
Temperature Coefficient: 0.1 x (specified accuracy) per °C for temperatures <18°C or > 28°C
Electro-Magnetic Interference (EMI): The 25 & 27 meet MIL-STD-461 for RS03 (radiated susceptibility to 1V/meter from 14 kHz to 1 GHz) and REO2 (radiated emissions).
Relative Humidity: 0% to 95% (0°C to 35°C) 0% to 70% (35°C to 55°C)
Power: Single 9V NEDA 1604 or 6F22 or 006P
Battery Life: >1000 hours typical
Battery Indicator: Symbol first displayed when 60 hours of life remain
Safety: Protection Class II per IEC 348, ANSI C39.5, UL 1244 listed. Meets MIL-STD-810C, Method 511.1, Procedure/Explosive Atmosphere Test
Size: 56 mm H x 95 mm W x 203 mm L (2.2 in H x 3.75 in W x 8 in L)
Weight: 0.75 kg (1.6 lb)
C20 Case Size: 102 mm H x 152 mm W x 262 mm L (4 in H x 6 in W x 10.3 in L)
Note: Case is 330 mm L (13 in L) including handle

Ordering Information

Models

Fluke 25 STD Multimeter
Fluke 25 YEL Multimeter
Fluke 27* STD Multimeter
Fluke 27* YEL Multimeter

**With MIN/MAX storage and Relative Modes*

Included with Instrument

Three-year product warranty, one-year on calibration cycle, battery installed, TL75 test leads, two insulated alligator clips, spare fuse, and operator's manual. Available in charcoal grey (STD model) or yellow (YEL model).

Accessories (Also see Section 7)
TL20 Industrial Test Lead Set
TL70A Right Angle Test Lead Set
Y8134 Universal Test Lead Kit
Y8140 Needle Point Test Lead Set
C20 Hard Case
C25 Ruggedized Soft Case
C100 Universal Carrying Case
83RF High Frequency Probe, 100 MHz
85RF High Frequency Probe, 500 MHz
80TK Thermocouple Module
80T-150U Universal Temperature Probe
80J-10 Current Shunt
Y8100 Clamp-on DC/AC Current Probe
Y8101 Clamp-on AC Current Probe
80i-400 Clamp-on AC Current Probe
80i-410 Clamp-on DC/AC Current Probe
80i-600 Clamp-on AC Current Probe
80i-1010 Clamp-on DC/AC Current Probe

Manuals
25/27 Operator*
25/27 Service
**No charge with purchase of unit*

Factory Warranty
Three-year product warranty.

AVAILABLE THROUGH DISTRIBUTORS

8025B Multimeter

The 8025B is identical to the Fluke 27 in form and functions but is designed to conform to the enviromental requirements of MIL-T-28800 Type II, Class 2, Style A which includes a -40°C to 55°C operating range. The meter comes with a C100 ruggedized hard case and low temperature test tools.

Specifications

Technical Specifications

Basic electrical specifications are defined for the temperature range of 18°C to 28°C and relative humidity up to 95%, for one year after calibration.
Low Temperature Operation: at -40°C LCD updates may take more than 6 seconds

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0 mV	100 µV	0.2% + 1
3.200V	1 mV	
32.00V	10 mV	
320.0V	100 mV	
1000V	1V	

Input Impedance: 10 MΩ nominal
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB at dc, 50 Hz or 60 Hz; ≤1 kΩ unbalance
Overload Protection: 1000V rms; 500V rms on 320 mV range
Response Time: ≤2s to rated accuracy

AC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)		
		40 Hz-2 kHz	2 kHz-10 kHz	10 kHz-30 kHz
320.0 mV	100 µV	0.5%+3	2% + 3	4%+10
3.200V	1 mV			
32.00V	10 mV			
320.0V	100 mV			
1000V	1V	1% + 3	3% + 3	Not Spec'd

Conversion Type: AC coupled, average sensing, calibrated to read rms value of sine wave
Input Impedance: 10 MΩ nominal in parallel with ≤100 pF
Common Mode Rejection Ratio: ≥60 dB, dc to 50 Hz; ≤1 kΩ unbalance
Overload Protection: 1000V rms, 500V rms on 320 mV range; 10^7 volt-hertz maximum
Response Time: ≤2s to rated accuracy

DC and AC Current

Range	Resolution	Typical Burden Voltage	Accuracy: ±(% of Rdg + Digits)	
			DC Accuracy	AC 40 Hz to 1 kHz
320.0 µA	0.1 µA	160 mV	0.75% + 2	1.5% + 2
3200 µA	1 µA	1.6V		
32.00 mA	10 µV	180 mV		
320.0 mA	100 µA	1.8V		
10.00A	10 mA	0.5V		

Overload Protection: µA/mA ranges: 630 mA/250V fuse in series with 3A/600A fuse
Amp Range: 20A/600V fuse

Resistance

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0Ω	0.1Ω	0.3% + 2
3.200 kΩ	1Ω	0.2% + 1
32.00 kΩ	10Ω	
320.0 kΩ	100Ω	
3.200 MΩ	1 kΩ	
32.00 MΩ	10 kΩ	1% + 1
32.00 nS	0.01 nS	2% + 10

Overload Protection: 500V rms
Full Scale Voltage: <420 mV up to 3.2 MΩ; <1.3V up to 32 MΩ
Open Circuit Voltage: <2.8V (-15°C to 55°C)
Response Time: ≤6s to rated accuracy

Diode Test and Continuity

Diode Test Indication: Displays voltage drop; 0.5 mA nominal test current at 0.6V; 2.08V full scale
Continuity Indication: Continuous audible tone for test resistance below 150 ohms. Momentary tone for test voltage dropping below 0.7V (typical silicon diode threshold)
Open Circuit Voltage: <3.3V (-15°C to 55°C)
Overload Protection: 500V rms

General Specifications

MIN/MAX Mode: Records the digital display readings (updated twice per second)
Maximum Voltage to be applied to any terminal: 1000V with respect to earth ground
Power Requirements: Single 9V battery NEDA 1604. Lithium battery recommended for low temperature operation
Battery Life: 1000 hours typical. Battery symbol first displayed when at least 60 hours of battery life remain. Battery life shortens significantly at low temperature. Lithium battery recommended for low temperature operation.
Storage Temperature: -55°C to 85°C
Operating Temperature: -40°C to 55°C
Temperature Coefficient: 0.1 x applicable accuracy specification per °C (for temperatures <18°C or >28°C)
Electro-Magnetic Interference (EMI): The 8025B meet MIL-STD-461 for RS03 (to 1V/meter from 14 kHz to 1 GHz) and RE02
Shock, Vibration, Humidity and Water Resistance: Per MIL-T-28800 for a Style A, Class 2 instrument
Instrument Size: 56 mm H x 95 mm W x 203 mm L (2.2 in H x 3.75 in W x 8 in L)
C100 Case Size: 121 mm H x 337 mm W x 394 mm L (4.75 in H x 13.25 in W x 15.5 L)
Weight: DMM alone is 0.75 kg (1.6 lb) with case and accessories 1.5 kg (3.2 lb)
Warranty: Two years

Ordering Information

Model

8025B Multimeter (NSN 6625-01-266-3494)

Included with Instrument

Two-year product warranty, battery, low temperature test leads, two insulated alligator clips, Instruction manual, TL25B stray voltage test lead set, with a 1 kΩ thermistor load for DMM input, and C100 ruggedized hard case.

Accessories

TL20	Test Lead Set
TL25B	Stray Voltage Test Leads
Y8134	Universal Test Lead Kit
C25	Soft Carrying Case
83RF	High Frequency Probe, 100 MHz
85RF	High Frequency Probe, 500 MHz
80TK	Thermocouple Converter
80T-150U	Universal Temperature Probe
80K-6	High Voltage Probe
80K-40	High Voltage Probe
80J-10	Current Shunt
Y8100	DC/AC Current Probe
Y8101	AC Current Probe
80i-400	AC Current Probe
80i-410	DC/AC Current Probe
80i-600	AC Clamp-on Current Probe
80i-1010	DC/AC Current Probe

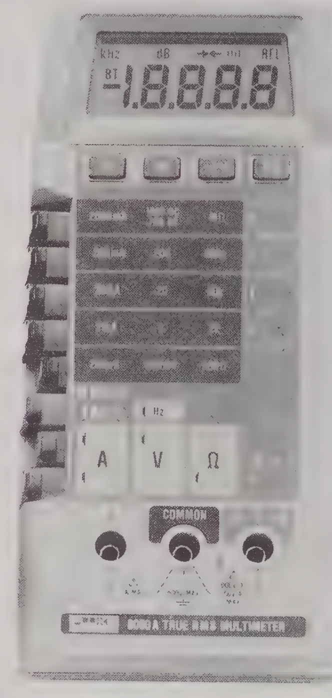
8060A & 8062A

Available through Distributors

BT
-1.8.8.8.8
REL
A
V
Ω
COMMON
8062A TRUE RMS MULTIMETER

LISTED
UL
1244

(NSN 6625-01-160-4299) **8062A**



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(NSN 6625-01-157-2246) **8060A**

8062A 4½ Digit DMM
4½ digit (20,000 count) resolution
True-rms ac measurements
Fast audible/visual continuity tests
Relative reference (offset)
Low-power ohms all resistance ranges
Constant-current diode test mode
Measure resistances to 300 MΩ
True-rms ac voltages to 30 kHz
0.05% basic dc accuracy
Self diagnostics
UL 1244 listed
1-year warranty

8060A 4½ Digit DMM
4½ digit (20,000 count) resolution
True-rms ac measurements
Fast audible/visual continuity tests
Relative reference (offset)
Low-power ohms all resistance ranges
Constant-current diode test mode
Measure resistances to 300 MΩ
True-rms ac voltages to 100 kHz
0.04% basic dc accuracy
Self diagnostics
UL 1244 listed
1-year warranty
Plus
Frequency Counter...12 Hz to 200 kHz
functional to 700 kHz
dBm or relative dB measurements
Conductance measurements

The 8060A and 8062A 4½ digit handheld DMMs offer more measurement capabilities than found in most bench/portable models. They are Fluke's finest microcomputer-based handheld DMMs offering unique features never before found in a small low-cost DMM. The 8060A even measures *frequency* – from 12 Hz to more than 200 kHz – autoranging over four ranges from 200 Hz to 200 kHz.

At the touch of a single button you can select V, Hz, and dB.

Relative Reference

When measuring ohms, the microcomputer lets you automatically subtract lead resistance, displaying only the difference between a stored reference value and a measured value. The relative mode is great for measuring changes, especially in dB and frequency measurements.

Overload Protected & Rugged

The 8060A and 8062A are well-suited to the needs of engineers and technicians skilled in audio, video, telecommunication, or computer technology. They have rugged cases, safety engineered jacks and test leads, double-fused current inputs, and extensive overload protection for all other functions and ranges.

Automatic MΩ Range Selection

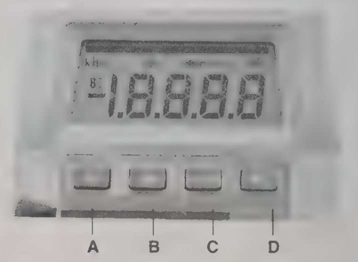
To keep the front panel simple, there is only one manually-selectable position above 200 kΩ. When that position is used, the appropriate 2 MΩ, 20 MΩ, or 300 MΩ range is automatically selected.

Frequency Counter

It is easy to accurately measure the dB gain or loss of amplifiers, filters, attenuators, etc. with a DMM that has dB readout. To combine that feature in a handheld DMM that also measures *frequency* provides a nearly ideal test instrument for many applications. When you need the best in a handheld DMM, you should buy the 8060A. It has features you won't find even in most bench/portable DMMs.

True-RMS AC

Because true-rms measurements of ac yield accurate results on non-sinusoidal waveforms as well as sine waves, the 4½ digit resolution, wide



8060A & 8062A

bandwidth, and exceptional accuracy of the 8060A and 8062A make them a superior tool for exacting technical people.

Special Functions

Several special annunciator symbols appear in the display as a reminder of what mode or modes have been selected when pushbuttons **A,B,C,** and **D** are used. Only pushbuttons **C** and **D** and corresponding functions appear on the 8062A.

(A) Pushing the Hz button when in the ac voltage mode selects the frequency function. The best of four ranges (200 Hz, 2 kHz, 20 kHz, and 200 kHz) is then automatically selected for frequencies between 12 Hz and 200 kHz. Readings are updated every 1.3 seconds or less even for low-frequency ranges.

(B) Pushing the dB button converts voltage readings to the equivalent in decibels. The reading may be relative to 1 milliwatt (dBm) and a 600 ohm load, or they may be relative to any level previously stored as a "relative reference."

(C) This pushbutton converts resistance measurements to fast indications of continuity, either audibly with a beep tone or quietly by the appearance of the solid black bar across the top of the display. Continuity as brief as 50 microseconds is enough to be recognized, stored, and indicated.

(D) When you first push the REL button it stores the displayed reading and subsequently subtracts that value from all subsequent readings for that measurement function. REL appears in the display as a reminder until the 8060A or 8062A is turned off or the pushbutton is pressed a second time.

Specifications

Technical Specifications

All accuracy specifications apply for one year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 80%, unless otherwise noted.

DC Voltage

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V
Resolution: 10 µV on the 200 mV range
Input Impedance: 10 MΩ on all ranges, >1000 MΩ selectable for 200 mV and 2V ranges
Accuracy: ±(% of rdg + digits)

Range	8060A	8062A
200 mV, 2V	0.04% + 2*	0.05% + 2
20V, 200V, 1000V	0.05% + 2	0.07% + 2

**Accuracy ± (0.05% of reading + 2 digits) for >1000 MΩ input impedance*

Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB at dc, ≥90 dB at 50 Hz and 60 Hz, with 1 kΩ unbalance
Overload Protection: 1000V dc, 750V rms ac (not to exceed a volt-hertz product of 10^7) on all ranges, continuous except limited to 20 seconds on 200 mV and 2V ranges
Response Time: ≤1 second to rated accuracy

AC Voltage (True-RMS, AC Coupled)

Ranges: 200 mV, 2V, 20V, 200V, 750V
Resolution: 10 µV on the 200 mV range
Input Impedance: 10 MΩ, ≤100 pF (dBm mode also)
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Voltage Readout, 8060A: From 5% to 100% of range

Range	Accuracy: ±(% of Rdg + Digits)					
	20 Hz–45 Hz	45 Hz–1 kHz	1 kHz–10 kHz	10 kHz–30 kHz	30 kHz–50 kHz	50 kHz–100 kHz
200 mV	1% +10	0.2% +10	0.2% +20	0.5% +40	1% +100	3% +200
2V 20V 200V		0.5% +10	0.5% +20	1% +40	2% +100	
750V	Not Spec'd	1% +10	Not Specified			

Voltage Readout, 8062A: From 5% to 100% of range

Range	Accuracy : ±(% of Rdg + Digits)				
	20 Hz–45 Hz	45 Hz–500 Hz	500 Hz–1 kHz	1 kHz–10 kHz	10 kHz–30 kHz
200 mV 2V	1% +10	0.5% +10	0.5% +20		1% +40
20V 200V			5% +20		5% +40
750V	Not Spec	2% + 10		Not Spec'd	

dBm, 600Ω Reference, 8060A: From 5% to 100% of range (-50 to +60 dBm)

Range	Accuracy in dB					
	20 Hz–45 Hz	45 Hz–1 kHz	1 kHz–10 kHz	10 kHz–30 kHz	30 kHz–50 kHz	50 kHz–100 kHz
2.45 mV-10.23 mV	±0.5	±1.0		±3.0	Not Spec'd	
10.24 mV-19.99 mV	±0.2			±0.5	±1.0	±2.2
20 mV-199.99V	±0.15			±0.3	±0.65	±1.2
200V-750V	±0.5		Not specified			

Useful Frequency Range: -3 dB at 420 kHz at 100% of range, 220 kHz at 5% of range, typical
Common Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz, 1 kΩ unbalance
Overload Protection: 1000V dc or peak ac, 750V rms ac (not to exceed a volt-hertz product of 10^7) on all ranges, continuous, except 300V dc or rms ac on the 200 mV and 2V ranges for 20 seconds maximum
Response Time: ≤5 seconds to rated accuracy, any range

DC Current

Range	Resolution	Accuracy: ±(% Rdg + Digits)		Burden Voltage
		8060A	8062A	
200 µA 2 mA	0.01 µA 0.1 µA	0.2% + 2	0.3% + 2	≤0.3V
20 mA	1 µA	0.3% + 2		
200 mA	10 µA		0.7% + 2	
2000 mA	100 µA			≤0.9V

Input Protection: 2A/250V fuse in series with 3A/600V fuse
Response Time: ≤1 second to rated accuracy

AC Current (True-RMS)

Has dc-coupled current path, ac-coupled voltage-sensing circuits
Ranges, Resolution, Burden Voltage: Same as for dc current
Accuracy, 8060A: ±(% of Rdg + Digits) from 5% to 100% of range

Range	20 Hz-45 Hz	45 Hz-3 kHz	3 kHz-10 kHz	10 kHz-30 kHz
200 µA 2 mA 20 mA	1% +10	0.75% +10	2% +20	2% +40
200 mA				
2000 mA			Not Specified	

Accuracy, 8062A: ±(% of Rdg + Digits) from 5% to 100% of range

Range	20 Hz-45 Hz	45 Hz-3 kHz	3 kHz-10 kHz	10 kHz-30 kHz
200 µA 2 mA 20 mA	1% +10	0.75% +10	2% +20	2% +40
200 mA	1.5% +10	1% +10		
2000 mA			Not Specified	

Crest Factor: 1:1 to 3:1
Response Time: ≤5 seconds to rated accuracy

8060A & 8062A

Resistance

Ranges: 200Ω, 2Ω, 20 kΩ, and 200 kΩ manually selected plus 2 MΩ, 20 MΩ, 100 MΩ, and 300 MΩ automatically selected in the MΩ range

Resolution and Accuracy

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		8060A	8062A
200Ω	0.01Ω	0.07% + 2 + 0.02Ω	0.1% + 2 + 0.02Ω
2 kΩ 20 kΩ 200 kΩ	0.1Ω 1Ω 10Ω	0.07% + 2	0.1% + 2
2 MΩ*	100Ω	0.15% + 2	0.2% + 2
20 MΩ*	10 kΩ	0.2% + 3	0.25% + 3
100 MΩ*	100 kΩ	1% + 3	1% + 3
300 MΩ*	1 MΩ	2% + 3	2% + 3

**These four autoranging MΩ ranges have a high enough source voltage to turn on a silicon junction.*

Open Circuit Voltage: ≤2.5V all ranges, except ≤4.8V on 200Ω range
Overload Protection: 500V dc or rms ac on all ranges
Response Time: ≤2 seconds to rated accuracy except ≤8 seconds on MΩ ranges

Continuity

Ranges: All resistance ranges
Threshold: For 8060A, ≤10% of any range used through 200 kΩ range and ≤20 kΩ above 200 kΩ range. For 8062A ≤50% of range and nominally <100 kΩ above 200 kΩ range
Indication: Horizontal bar in display, plus audible tone when desired
Response Time: ≤50 µs continuity, ≥200 ms indication

Diode Test

The diode test function displays the voltage-drop across a semiconductor junction using a 1 mA (±10%) constant current supply and a 2V range. All resistance ranges up to and including the 200 kΩ range have less than enough source voltage to forward-bias a semiconductor junction, so that they can be used for in-circuit measurements.
Reading Accuracy: ±(0.05% + 2 digits) for 8060A, ±(0.06% + 2 digits) for 8062A
Overload Protection: 500V dc or rms ac
Response Time: ≤2 seconds to rated accuracy

Conductance (8060A only)

Range: 2000 nS (equivalent to 500 kΩ)
Resolution: 0.1 nS
Accuracy: (0.5% of reading + 20 digits)
Overload Protection: 500V dc or rms ac

Relative Reference

When the REL button is pushed the displayed reading is stored as a reference and subtracted from subsequent readings to indicate the amount of deviation.
Accuracy: Error will not exceed the sum of the errors of the reference reading and subsequent readings

Frequency (8060A only)

Ranges: 200 Hz, 2000 Hz, 20 kHz, and 200 kHz, automatically selected in the Hz mode, ac voltage function. Measures down to 12 Hz. Will measure to 700 kHz in Extended Frequency Mode.
Resolution: 0.005% of range, e.g., 0.01 Hz in 200 Hz range
Accuracy: ±(0.05% of reading + 1 digit)
Input Inpedance: AC coupled into 10 MΩ, 100 pF
Sensitivity: For sine waves, ≥10% of voltage range to 20 kHz, ≥25% of voltage range to 100 kHz, ≥75% of voltage range to 200 kHz
Response Time: ≤1 second above 16 Hz, ≤1.3 seconds from 12.2 Hz to 16 Hz, to rated accuracy

General Specifications

Calibration Cycle: One-year for specified accuracy
Display: 4½ digits (20,000 counts), LCD, autozero, autopolarity, low battery (BT) indicator
Max Common Mode Voltage: 500V dc or rms ac
Temperature: 0°C to 50°C operating; -35°C to 60°C non-operating
Temperature Coefficient: ≤0.1 times the applicable accuracy specification per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤70% to 50°C or ≤80% to 35°C but ≤70% when measuring reisistance above 20 MΩ
Shock and Vibration: Per MIL-T-28800, Class 5
Safety: UL 1244 listed, ANSI C39.5, IEC 348 Class II, and CSA Bulletin 556B
Power: Single 9V battery, NEDA 1604, typically 170 hours of operation with alkaline type
Size: 180 mm L x 86 mm W x 45 mm H (7.1 in L x 3.4 in W x 1.8 in H)
Weight: 0.41 kg (0.90 lb)

Ordering Information

Models

8060A Digital Multimeter
8062A Digital Multimeter

Included with Instrument
One-year product warranty, Instruction manual, TL70A test leads, 9V battery, Operator's card and spare fuse.

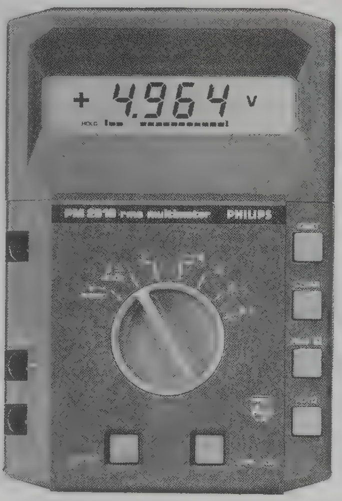
Accessories (Also see Section 7)
TL20 Industrial Test Lead Set
TL70A Test Lead Set
Y8132 Test Lead Set
Y8134 Universal Test Lead Kit
Y8140 Test Lead Set
C25 Soft Carrying Case
C90 Vinyl Carrying Case
C100 Hard Carrying Case
A81 Battery Charger/Eliminator
83RF High Frequency Probe, 100 MHz
85RF High Frequency Probe, 500 MHz
80TK Termocouple Converter
80T-150U Universal Temperature Probe
80K-6 High Voltage Probe
80K-40 High Voltage Probe
80J-10 Current Shunt
Y8100 DC/AC Current Probe
Y8101 AC Current Probe
80i-400 AC Current Probe
80i-410 DC/AC Current Probe
80i-600 AC Clamp-on Current Probe
80i-1010 DC/AC Current Probe
80i-kW Current/Power Probe

Manuals
8060A Instruction*
8060A Operator Card*
8062A Instruction*
8062A Operator Card*
**No charge with purchase of unit*

Factory Warranty
One-year product warranty.

AVAILABLE THROUGH DISTRIBUTORS

PM 2518, PM 2618, PM 2718 (Series 18)



PM 2518

Series 18 Handheld Multimeters

- High resolution analog bargraph
- Logic measurements to 10 MHz
- Frequency measurements to 200 kHz
- Min/Max and data hold
- mAs option for medical applications
- Electronic closed-case calibration
- 750V ohms protection
- 0.1%, 0.07% and 0.04% basic accuracy
- Backlight LCD option

Benchtop Performance in Handheld Size

These Series 18 DMMs are portable and compact, convenient for use in the laboratory or field, yet with all the performance and features expected of benchtop instruments.

The range of three models allows you to select exactly the functions you need for your application and environment, from general purpose testing, through communications and digital measurements, right up to R&D. Series 18 DMMs offer an excellent combination of value, convenience and performance.

High Accuracy Display

The 4+ digit display permits fast, high resolution measurements to be made on all functions. For example, 5V is measured to the nearest millivolt, with an accuracy of 0.1% or better.

AC True RMS Values, Accurate up to 100 kHz

The Series 18 DMMs have a custom true rms converter that guarantees accurate measurements on all ac signals (ac coupled). The following table compares the readings given for various input waves for the Series 18 meters and standard averaging instruments

Signal Form	⎍	∿	∧	⩘
RMS	5V	5V	5V	5V
Reading on Series18 % error	5V 0	5V 0	5V 0	5V 0
Reading on averaging meter % error	5V 0	5.55V 11	4.75V 6	3.2V 36

750V Protection for Reliability

With standard 750V input protection on all modes except current, the Series 18 handheld meters have excellent protection against accidental overload.

They can be connected to three-phase power supplies and the function switch can be rotated through the ohms range without damaging the meter.

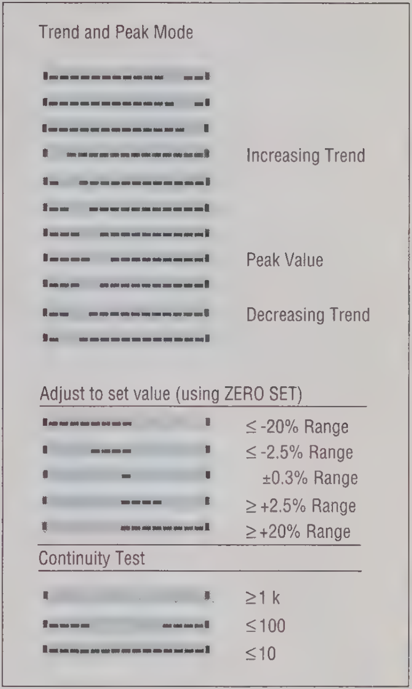
Standard dc and ac voltage range is 1 kV, protected to withstand 2.5 kV spikes, ensuring that these meters are not damaged in tough measuring conditions.

Bargraph Display

In checking signal trends or looking for peak values, the Series 18 bargraph display is a step forward over conventional analog pointer systems. For example, as long as the input signal is increasing, the rotating bargraph moves to the right. When autoranging of the digital display value occurs, the bargraph continues to move to the right, always giving a clear indication of the signal trend, even when the signal crosses meter ranges.

For accurate detection of peak values, for example, when tuning communication equipment, the bargraph has a maximum resolution equivalent to 8 counts on the digital display, or 0.08% of an analog scale.

For adjustment to set values, the ZERO SET mode of the Series 18 meters allows the bargraph to function as a highly sensitive minus-null-plus indicator. This allows accurate analog-indicated settings to any value within the meter's measuring range to an accuracy of 0.3%. And continuity testing not only gives an audible warning, but also a visual indication on the bargraph display.



Choice of Models

PM 2518

- AC true rms (ac-coupled)
- 750V ohms protection
- Analog bargraph
- Closed-case calibration
- Relative measurements
- dB measurements
- Temperature measurements
- 0.1% dc accuracy
- 40 kHz range

PM 2618

All PM 2518 features plus . . .
- 0.07% dc accuracy
- 70 kHz ac range
- 200 kHz counter
- 10 MHz logic detection
- mAs option

PM 2718

All PM 2618 features plus . . .
- 0.04% dc accuracy
- 100 kHz ac range
- Min/Max measurements
- Data capture and hold

PM 2518, PM 2618, PM 2718 (Series 18)

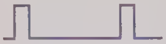
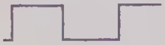
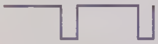
Added Features

10 MHz LOGIC Detection

(PM 2618 and PM 2718 only)

Digital signal activity at speeds of more than 10 MHz can be meaningfully indicated by the LOGIC function. This allows not only high, low, bad or pulsed logic levels to be detected, but also gives an indication of the duty cycle at the measured point. The ability to distinguish between bad levels and real open circuits considerably reduces troubleshooting time.

At 'any logic,' compatibility is simply achieved by connecting the measuring leads to the low and V cc levels in the circuit to be tested, and pressing the ZERO button. The thresholds for the LOGIC mode are then set to 25% (low) and 75% (high) of this value, thereby covering the full range of logic levels – from low-power CMOS to industrial hardwired logic.

Input	Display
	HOLD - n - - PROBE
	HOLD nnnn PROBE
	HOLD - U - - PROBE
	- - - - HOLD PROBE
	HOLD bAd PROBE
	HOLD - - - - PROBE
Open Circuit	HOLD OPEn PROBE

mAs Version (PM 2618 only)*

Where milliamp second measurements are required, for example in medical environments, the PM 2618/323 version allows these to be made in addition to any other standard functions. A single switch allows selection of mA, mAs measure or mAs zero. Measurement of pulses from 0.5 ms to 1s in the range 10 µAs to 20 As ensures compatibility with current and future X-ray systems and scanners. This special version also includes the backlight display, with automatic on/off switching depending on the ambient light level.

Resistance Measurements from Short Circuit to 100 MΩ

Fast circuit-continuity checks are possible with a beeper that gives an instant warning of short-circuits, while resistance values from 100 mΩ to 100 MΩ are displayed clearly and with optimum resolution via the autoranging.

Easy to Read in the Dark

Where measurements have to be made under poor lighting conditions, for example among tightly packed equipment or in out-of-the-way areas, special backlight versions of the new Series 18 DMMs have a display light that switches on automatically. If no new measurement is made, the backlight switches off after a short period to conserve battery life. Complete power-down of the instrument takes place after 30 minutes on both standard and backlight versions. Combined with low power consumption in normal use, this contributes to a battery lifetime of hundreds of hours.

Direct Temperature Readings

The optional PM 9249 Platinum RTD 100 probe gives direct temperature readings from -60°C to +200°C, with a resolution of 0.1°C for air, liquid or surface temperatures.

Direct Gain and Loss Measurements

Measurements on amplifiers or communications equipment frequently require the conversion of readings into dB values. This is available with a single button operation on the Series 18, to a resolution of 0.1 dB and eliminating the need for separate calculations.

Relative Reference Values

Measurements of tolerances or component deviations from specified values are simple with the Series 18. A reference relative value can be set using the ZERO button, so the user does not always have to make the measurement relative to zero and calculate the deviation. Measurements are then made automatically, relative to that reference value.

200 kHz Frequency Counter Function (PM 2618, PM 2718 only)

An automatic counter function works at frequencies from 1 Hz to 200 kHz. Readout is direct, with a scale indication showing Hz or kHz. It is highly sensitive, making it suitable for audio applications.

MIN/MAX Readout (PM 2718 only)

To monitor minimum and maximum levels in test set-ups, all the user has to do is connect the PM 2718 and begin measuring. Minimum and maximum readings can be recalled and displayed at any time; and maximum and minimum readings of low-frequency signals (±1Hz) can be measured and read within a few seconds.

Data Capture and Hold

The PM 2718 data capture function allows a measured value to be frozen on the display, essential when working in situations where access to the measurement point is difficult. The PM 2718 offers this as standard and it is optionally available on all Series 18 instruments with the data hold probe PM 9267. The user simply connects the measuring leads, waits for the "beeper" to confirm that the measurement has been acquired, and it can be read whenever it is needed.

Closed-Case Calibration

The Series 18 DMMs are the first compact battery-powered units to offer closed-case calibration, a capability normally found only on much more expensive instruments. This facility allows savings in calibration time and cost and ensures error-free calibration.

Specifications

Technical Specifications

Display: LCD, 12 mm height with range and message characters
A/D Conversion System: Delta modulation, autozeroing, 11,000 counts
Reading Rate: 2.5 measurements/s
CMRR DC: >100 dB
CMRR 50/60 Hz: >80 dB
SMRR 50/60 Hz: >60 dB
Ranging: Fully automatic except 100 MΩ
Range Selection: Autorange up at 110% of fs; autorange down at 10% of fs; manual ranging by key
Overload: Indicated by OL on display
Underload (dB): Indicated by UL on display
Crest Factor Overload: Indicated by ↑ on display
High Voltage 110V: Indicated by ↯ on display
Max V x Hz: 10^7

Logic Function (PM 2618 and PM 2718)

V cc of test unit entered by use of ZERO key on meter
Default V cc: 3.2V (gives 0.8V and 2.4V)
Logical 0 Level: ≤0.25V cc
Logical 1 Level: ≥0.75V cc
Threshold Resolution: ±50 mV

*Available through Distributors

PM 2518, PM 2618, PM 2718 (Series 18)

Function	Meter Ranges	Resolution	Accuracy (% reading + % range)			Input characteristics	Response Time	Overload Protection	Notes
			PM 2518	PM 2618	PM 2718				
V dc	1V 10V 100V 1000V	100 μV 1 mV 10 mV 100 mV	0.1 + 0.02 0.1 + 0.02 0.1 + 0.02 0.1 + 0.02	0.07 + 0.02 0.07 + 0.02 0.07 + 0.02 0.1 + 0.02	0.04 + 0.02 0.04 + 0.02 0.04 + 0.02 0.1 + 0.02	10 MΩ 10 MΩ 9.1 MΩ 9.1 MΩ	Manual <1s Auto <1.5s	1000V rms 2.5 kV spike	
V ac (ac coupled, True rms, crest factor 2)	1V 10V 100V 1000V	100 μV 1 mV 100V 1000V	40 Hz to 3 kHz 0.5 + 0.1 3 kHz-40 kHz per kHz 0.20 + 0.05	40 Hz to 3 kHz 0.4 + 0.1 3 kHz-70 kHz per kHz 0.15 + 0.03	40 Hz to 3 kHz 0.3 + 0.1 3 kHz-100 kHz per kHz 0.1 + 0.03	>2 MΩ <20 pF	Manual <1s Auto <1.5s	1000V rms 2.5 kV spike	
I dc	20 mA 200 mA 2A 10A (20A<20s)	10 μA 100 μA 1 mA 10 mA	0.5 + 0.1 0.5 + 0.1 0.5 + 0.1 0.5 + 0.1	0.4 + 0.1 0.4 + 0.1 0.4 + 0.1 0.4 + 0.1	0.4 + 0.1 0.4 + 0.1 0.4 + 0.1 0.4 + 0.1	<25 mV drop <250 mV drop <25 mV drop <250 mV drop	Manual <1s Auto <1.5s	20 mA and 200 mA ranges fuse protected	Voltage drop excludes fuse on 20 mA and 200 mA ranges
I ac (ac coupled True rms , crest factor 9)	20 mA 200 mA 2A 10A (20A<20s)	10 μA 100 μA 1 mA 10 mA	0.06 + 0.3 40 Hz-400 Hz	0.6 + 0.3 40 Hz-400 Hz	0.4 + 0.3 40 Hz-400 Hz	Voltage drop as I dc	Manual <1s Auto <2	as I dc	as I dc
R	1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MQ 100 MΩ	100 mΩ 1Ω 10Ω 100Ω 1 kΩ 100 kΩ	0.3 + 0.1 0.3 + 0.1 0.3 + 0.1 0.3 + 0.1 0.5 + 0.1 5 + 3	0.2 + 0.1 0.2 + 0.1 0.2 + 0.1 0.2 + 0.1 0.4 + 0.1 5 + 3	0.15 + 0.05 0.15 + 0.05 0.15 + 0.05 0.15 + 0.05 0.3 + 0.1 5 + 3	1 mA drive 100 μA drive 10 μA drive 1 μA drive 100 nA drive 10 nA drive	Manual <1s Auto <3s 10s	750V	Open input Voltage 3V 100 MΩ Manual ranging
Hz PM 2618 and PM 2718 only	20 kHz 200 kHz	1 Hz 10 Hz	N.A. N.A.	0.1 + 0.01 0.1 + 00.1	0.1 + 0.01 0.1 + 0.01	≤1V p-p sensitivity 2 MΩ//3pF			10 Hz lower limit Gate time 1s
°C via Pt 100 100Ω RTD	-250°C to +1000°C	0.1°C	1°C in range -20 to +100°C	1°C in range -20 to +100°C	1°C in range -20 to +100°C	1 mA drive current	dependent on probe		PM 9249 range -60°C to +200°C
Diode Test	1V dc	100 μV	0.3 + 0.1	0.3 + 0.1	0.3 + 0.1	1 mA drive	<1s	750V p-p	
Continuity Test	1 kΩ	100 MΩ	0.5 + 0.1	0.5 + 0.1	0.5 + 0.1	1 mA drive	<0.2s	750V p-p	Beeper
dB V ac	-51 dB to +43 dB	0.1 dB (>100 mV) 1 dB (<100 mV)	as V ac	as V ac	as V ac	Referenced to 1 mW 600Ω	as V ac	as V ac	
dB V dc	-47 dB to +53.8 dB	0.1 dB(>10 mV) 1 dB (<10 mV)	±0.1dB(>10 mV) ±1dB(<10 mV)	±0.1dB(>10 mV) ±1dB(<10 mV)	±0.1dB(>10 mV) ±1dB(<10mV)	Referenced to 1 mW 50Ω	as V dc	as V dc	1 mW 50Ω
mAs	20 mAs 100 mAs 2 As 20 As	10 μAs 100 μAs 1 mAs 10 mAs	N.A.	1% + 0.3% (in 3% to 100% of range)	N.A.	as I dc	as I dc	as I dc	Optional PM 2618 only

Max V cc: 100V
Min Pulse Duration: 100 ns using 1:1 probe
Max Frequency: 10 MHz using 1:1 probe (above 10 kHz)
Beeper Function: On/off via FUNCTION key; low tone for logical 0; high tone for logical 1; intermittent high tone for pulse

Relative Measurement (using ZERO button)

Applicable Functions: All
Set Reference: On pushing ZERO button, last displayed value is used as reference
Recall Reference: By pushing and holding ZERO
Clear Reference: By key combination or autorange selection

BEEPER Functions

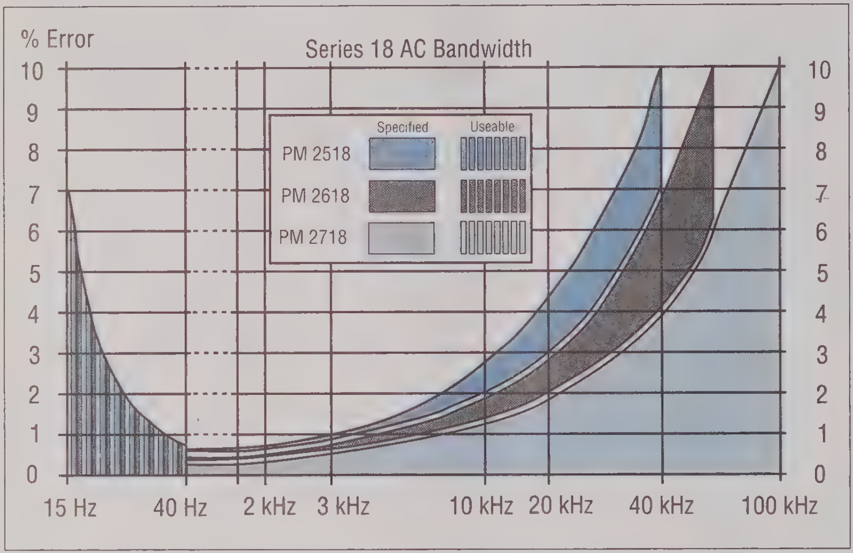
PM 2518 and PM 2618: Dual tone selectable for ohms; low ≤10%, high ≤continuity; low ≤10%, high ≤1% logic; see logic function
PM 2718: As PM 2618 plus data captured indication

mAs Measurement

Ranges: 20 mAs, 200 mAs, 2 As, 20 As
Maximum Input Current on 20A Socket: 10A continuous, 20A for 20s
Resolution: 10 μAs in 20 mAs range
Number of Representation Units: 2200
Accuracy: ±(1% of reading +0.3% of range) covering 3% to 100% of range
Temperature Coefficient: ±(0.06% of reading +0.06% of range)
Drift: <2 digits/s

Min Pulse Width: 0.5 ms
Max Pulse Width: 1s
Voltage Drop Over Shunt: 20 mAs, 2 As range, <25 mV at 20 mA resp 2A; 200 mAs, 20 As range, <250 mV at 200 mA resp 20A
Voltage Drop Over Input Sockets: 20 mAs, 2 As range, <100 mV at 20 mA resp 2A; 200 mAs, 20 As range, <1V at 200 mA resp 20A
Protection: 250V rms ranges, 20 mAs; range 2 As, 20 As not protected; max current 20A for 20s
Max Common Mode Voltage: 400V
Zero Setting Integration: By switching the ERASE knob
Relative Reference Setting: ON/RECALL; with pushbutton ZERO OFF; with pushbutton CLEAR
Maximum Voltage: HI and LO 250V rms; HI and GROUND 400V rms; LO and GROUND 400V rms

PM 2518, PM 2618, PM 2718 (Series 18)



General Specifications

Environmental Conditions

Reference Temperature: 23°C ±2°C
Rated Range of Use: 0°C to +45°C
Operating Range of Use: -10°C to +55°C
Storage & Transport: -40°C to +70°C
Limits of Humidity for Operation: 20% to 80%

Power Requirements

Power Supply: 4 x R14 batteries or PM 9218A Power Supply Adapter
Power Consumption: /02 versions 45 mW typical; /12 versions 189 mW typical (light on)

Safety and Calibration

Calibration Interval: 1 year
Max Dew Point: +28°C
Safety: Class II according to IEC 348/VDE 0411/ UL 1244

Mechanical Specifications

Size: 170 mm L x 55 mm W x 188 mm H (6.7 in L x 2.2 in W x 7.4 in H)
Weight: 0.7 kg (1.5 lb)

Ordering Information

Models

PM 2518/02 Standard version
PM 2518/12 Standard version w/backlight display
PM 2618/02 Extended version
PM 2618/12 Extended version w/backlight display
PM 2618/32 mAs version w/backlight display
PM 2718/02 High accuracy version
PM 2718/12 High accuracy version w/backlight display

Included with Instruments

One-year product warranty, PM 9266 safety leads and probes, spare fuses and Operator manual.

Accessories (Also see Section 7)

PM 9053 Adapter, Banana (m)-BNC (f)
PM 9071 Coax Cable, Banana (m) - Banana (m)
PM 9072 Coax Cable, Banana (m) - BNC (m)
PM 9210 1 GHz Probe, 50
PM 9212 Accessory Kit for PM 9210
PM 9213 100 MHz Probe
PM 9215/50 10 MHz Logic View Probe
PM 9218A/01n* Power Adapter (115V/50 Hz to 60 Hz)
PM 9244 AC/DC 30A Shunt
PM 9245 100A AC Current Probe
PM 9246/04 30 kV Probe
PM 9249/01 Platinum RTD Temperature Probe
PM 9266 /03 Pair of Safety Test Leads
PM 9267/01 Data Hold Probe
PM 9278/02 Carrying Case

*The n' indicates the required line cord. To select your line cord substitute the n' by:

1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

Manuals

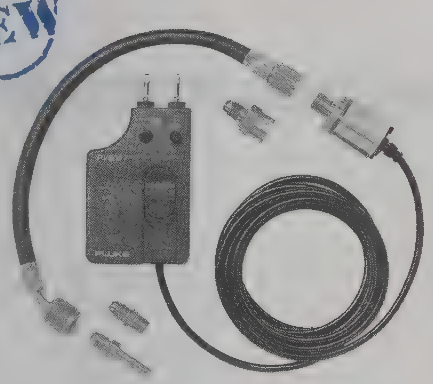
PM 2518/02/12, 2618/17 Service
PM 2518X Operator*
PM 2618/02/12 Operator
PM 2618/32 Operator
PM 2618X Operator*
PM 2718/02/12 Operator
PM 2718X Operator*

**No charge with purchase of unit*

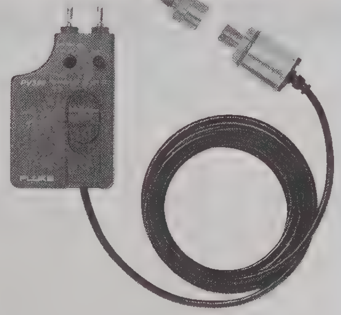
Factory Warranty

One-year product warranty.

Multimeter Accessories

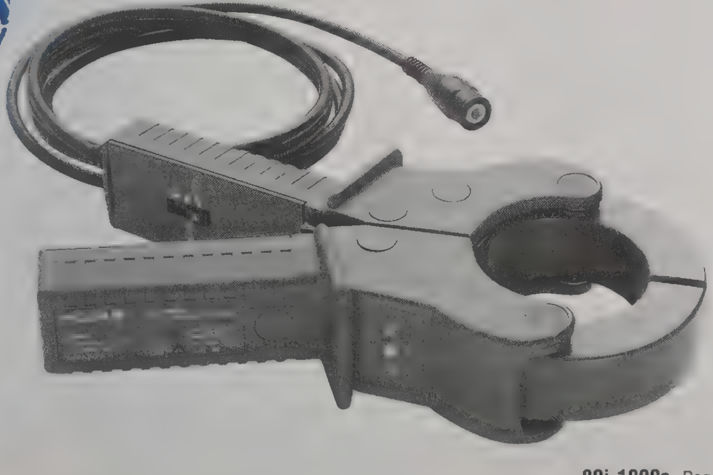


PV500 Page 151



PV350 Page 151

80T-IR Page 144



80i-1000s Page 143

Today's multimeters can become even more powerful tools through the use of accessories. High voltages and currents can be scaled down to levels that are safe to measure with a digital multimeter (DMM).

Temperature modules and thermocouple probes can convert a DMM to a thermometer.

New Pressure Vacuum modules add two new measurement capabilities to a digital multimeter. This section includes a wide assortment of carrying cases, test leads and special accessories. In total, Fluke offers more accessories for more digital multimeters than anyone in the world.

Our accessories are unsurpassed in quality of design and workmanship. And, they are compatible with other manufacturers' DMMs.

Accessory Compatibility Charts	Page 134
Test Leads, Probes & Clips	Page 137
Current Clamps	Page 140
Temperature Probes	Page 144
Protection & Storage	Page 147
Specialty Accessories	Page 151

Compatibility Charts

Available through Distributors

Accessory Compatibility Chart

Model Number	Item	Handheld														Bench/Portable						Bench/System			
		10, 11, 12	21/75 Series II	23/77 Series II	25/27	29/79 Series II	51, 52	70 Series II	73 Series II	78	83, 85	87	88	8060A	8062A	8010A	8012A	37	8050A	45	Hydra Series	8840 Series	8500 Series	8920A, 8922A	8921A
Test Leads, Probes & Clips																									
TL20*	Test Lead Set	•	•	•	•	•	—	•	•	•	•	•	•	•	•	—	—	•	•	•	•	•	—	—	—
TL22*	Test Lead	•	•	•	•	•	—	•	•	•	•	•	•	•	•	—	—	•	•	•	•	•	—	—	—
TL24*	Test Lead	•	•	•	•	•	—	•	•	•	•	•	(4)	•	•	—	—	•	•	•	•	•	—	—	—
TL26	Test Lead Set	•	•	•	•	•	—	•	•	•	•	•	•	•	•	—	—	•	•	•	•	•	—	—	—
TL28	Test Lead Set	•	•	•	•	•	—	•	•	•	•	•	•	•	•	—	—	•	•	•	•	•	—	—	—
TL70A*	Test Lead Set	•	•	•	•	•	—	•	•	•	•	•	•	(4)	(4)	—	—	•	(4)	(4)	(4)	(4)	—	—	—
TL75*	Test Lead Set	(4)	(4)	(4)	(4)	(4)	—	(4)	(4)	(4)	(4)	(4)	•	—	—	—	—	(4)	—	—	—	—	—	—	—
Y8131*	Test Lead Set	—	—	—	—	—	—	—	—	—	—	—	—	—	—	(4)	(4)	—	—	—	—	—	•	(1)	•
Y8132*	Test Lead Set	•	•	•	•	•	—	•	•	•	•	•	•	•	•	—	—	•	•	•	•	•	—	—	—
Y8133**	Test Lead Kit	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	•	—	—	—	—	—	•	(1)	•
Y8134	Test Lead Kit	•	•	•	•	•	—	•	•	•	•	•	•	•	•	—	—	•	•	•	•	•	—	—	—
Y8140**	Test Lead Set	•	•	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•
Current Probes																									
Y8100**	Current Probe	(12)	•	•	•	•	—	•	•	•	•	(9)	•	(8)	(8)	•	•	•	•	(10)	—	(6)	•	(1)	•
Y8101**	Current Probe	—	•	•	•	(11)	—	—	—	•	•	•	•	•	•	•	•	•	•	•	—	(6)	(3)	•	•
80i-400	Current Probe	—	•	•	•	(11)	—	—	—	•	•	•	•	•	•	—	—	•	•	•	—	(6)	—	—	—
80i-410	Current Probe	(12)	(7)	(7)	•	•	—	(7)	(7)	(7)	•	(9)	•	(8)	(8)	—	—	•	•	(10)	•	(6)	—	—	—
80i-600**	Current Probe	—	•	•	•	(11)	—	—	—	•	•	•	•	•	•	•	•	•	•	•	—	(6)	(3)	•	(3)
80i-1010	Current Probe	(12)	(7)	(7)	•	•	—	(7)	(7)	(7)	•	(9)	•	(8)	(8)	—	—	•	•	(10)	•	(6)	—	—	—
80i-kW	Current/Power Probe	(12)	(7)	(7)	•	•	—	(7)	(7)	(7)	•	(9)	•	(8)	(8)	—	—	•	•	(10)	•	(6)	—	—	—
80J-10**	Current Shunt	•	—	—	—	—	—	•	—	—	—	—	—	•	•	—	•	—	•	•	•	•	•	(1)	•
Temperature Products																									
80AK	Adapter	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80PK-1	Bead Probe	—	—	—	—	—	(15)	—	—	(4)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80PK-2A	Immersion Probe	—	—	—	—	—	•	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80PK-3A	Surface Probe	—	—	—	—	—	•	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80PK-4A	Air Probe	—	—	—	—	—	•	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80PK-5A	Piercing Probe	—	—	—	—	—	•	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80PK-6A	Exposed Probe	—	—	—	—	—	•	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80T-150U	Temperature Probe	(13)	•	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•
80T-IR	Infrared Temperature Probe	(13)	•	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•
80TK	Temperature Module	(13)	•	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•
Cases																									
C10	Holster	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C12	Soft Case	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C17Y	DuraCase™ - Yellow	(2)	•	•	—	•	•	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C20	Hard Case	—	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C25	Soft Case	—	(2)	(2)	•	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	(3)	—	—	—	—	—	—	—	—	—	—
C28Y	DuraCase - Yellow	—	—	—	•	—	—	—	—	—	(2)	(2)	(2)	—	—	—	—	—	—	—	—	—	—	—	—
C30	Replacement Holster	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C40	Soft Case	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	•	—	—	—	—
C50	Soft Case	—	•	•	—	•	•	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C70G	Holster Grey	—	•	•	—	•	•	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

• Means Compatible and recommended
— Not compatible, not recommended, or not applicable
** Listed to UL Safety Standards UL 1244*
*** Factory Mutual Approved*
† UL recognized

(1) Y9109 Adapter required
(2) On some ranges inputs must be shunted to equal 10 MΩ, useable on VDC only
(3) Current-measuring option required
(4) Included with DMM
(5) Feature of DMM alone
(6) Requires ac option for ac current
(7) 1 amp resolution for ac current, 1 amp resolution above 320A dc
(8) Minimum specified accuracy is 10A for ac current
(9) Minimum specifified accuracy is 20A for ac current
(10) Minimum specified accuracy is 15A for ac current
(11) Above 40A, 1 amp resolution for ac current, decimal shift required
(12) 1 amp resolution for ac or dc current
(13) 1 degree resolution for ° C or ° F
(14) 1 volt resolution, dc only, no ac
(15) One each included with the Fluke 51; two each included with the Fluke 52
(16) DC only
(17) 1 psi resolution, or 1 Hg resolution

Available through Distributors

Accessory Compatibility Chart (continued)

Model Number	Item	Handheld														Bench/Portable						Bench/System			
		10, 11, 12	21/75 Series II	23/77 Series II	25/27	29/79 Series II	51, 52	70 Series II	73 Series II	78	83, 85	87	88	8060A	8062A	8010A	8012A	37	8050A	45	Hydra Series	8840 Series	8500 Series	8920A, 8922A	8921A
Cases (continued)																									
C70Y	Holster Yellow	—	•	(1)	—	(1)	•	•	•	(1)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C81G	Holster Grey	—	—	—	—	—	—	—	—	—	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—
C81Y	Holster Yellow	—	—	—	—	—	—	—	—	—	(1)	(1)	(1)	—	—	—	—	—	—	—	—	—	—	—	—
C86	Hard Case	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	•	—	•	—	—	—	—	—	—
C90	Soft Case	—	(2)	(2)	—	(2)	(2)	(2)	(2)	(2)	—	—	—	•	•	—	—	—	—	—	—	—	—	—	—
C100	Hard Case	•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	—	—	—	—	—	—	—	—	—
C800	Hard Case	—	(3)	(3)	—	(3)	(3)	(3)	(3)	(3)	•	•	•	(3)	(3)	—	—	—	—	—	—	—	—	—	—
Y8205	Soft Case	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	•	—	•	—	—	—	—	—	—
Specialty Products																									
80K-6, †**	H.V. Probe	(14)	•	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	(16)	•	(2)	(2)	(1)	•
80K-40**	H.V. Probe	(14)	•	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	(16)	•	(2)	(2)	(1)	•
80T-H	Touch-Hold Probe	—	(5)	(5)	(5)	(5)	—	(5)	(5)	—	(5)	(5)	(5)	—	—	•	•	(5)	•	—	—	—	—	—	—
83RF**	RF Amplitude Probe	•	•	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•
85RF**	RF Amplitude Probe	•	•	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•
A81-115†	Battery Eliminator	—	—	—	—	—	—	—	—	—	—	—	—	•	•	—	—	•	—	—	—	—	—	—	—
PV350	Pressure/Vacuum Module	(17)	•	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•
PV500	Pressure/Vacuum Module	(17)	•	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•
Y9108	BNC Adapter	•	•	•	•	•	—	•	•	•	•	•	•	•	•	—	—	—	—	—	—	—	—	•	—
Y9109	BNC Adapter	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	•	•	•	•	•	•	•	—	•

• Means Compatible and recommended

— Not compatible, not recommended, or not applicable

(1) Included with DMM
(2) Accomodates DMM with Holster
(3) Loose fit
(5)Feature of DMM alone
(14) 1 volt resolution, dc only, no ac
(16) DC only
(17) 1 psi resolution, or 1 Hg resolution

Compatibility Chart for Test Leads and Attachments

Accessory Type	TP20	TP22	TP80	AC20	AC70A	AC75	AC80	AC83	AC85A	AC89
TL20 Set	☐	•	•	☐	•	•	•	•	•	•
TL22 Leads	•	•	•	•	—	•	•	•	•	•
TL24 Leads	•	•	•	•	—	•	•	•	•	•
TL26 Set	—	—	—	—	—	—	—	—	—	—
TL28 Set	—	—	—	—	—	—	—	—	—	—
TL70A/TL75 Set	—	—	—	—	•	—	—	—	—	—
Y8131 Set	•	•	•	•	—	•	•	•	•	—
Y8132 Set	•	•	•	•	—	•	•	•	•	•
Y8133 Kit	•	•	•	•	—		•	•	•	—
Y8134 Kit	•	•	•	•	—		•	•	•	•
Y8140 Set	—	—	—	—	•	—	—	—	—	—

• Compatible and recommended

— Not compatible, not recommended or not applicable

☐ Included with test lead set or kit

Multimeter Fuse Replacement Information

Models 21/23/73/75/77. P/N 871173: 630 mA 250V fuse in series with either P/N 871202: 3A 600V fuse or fusible resistor, R20 – DO NOT SUBSTITUTE FOR R20.

P/N 892583: 15A 600V fuse. Also recommended replacement for units with a fused 10A input using a 20A fuse.

Models 29/79 and 83/85/87. P/N 871207: 1A 600V fuse; P/N 892583: 15A 600V fuse.

Models 25/27. P/N 871173: 630 mA 250V fuse in series with P/N 871202: 3A 600V fuse. For units with 10A input using 20A fuse, use P/N 892583: 15A 600V fuse.

Models 8010A/8012A/8050A/8060A/8062A. P/N 871178: 2A 250V, and P/N 871202: 3A 600V fuse.

Required Replacements

Fluke P/N	871173	871207	871178	871215	871202	892583
Bussman	GDA.630	BBS-1	AGX-2	BBS-2	BBS-3	KTK-15
Littlefuse	216.630	–	361002	–	–	KLK-15

Application Notes

Fluke provides the following application notes. Ask your local wholesaler or call **(800) 87-FLUKE**, toll free in the USA.

Description	**Order No.**
Electrical Troubleshooting with Fluke Multimeters	B0171E
HVAC&R Systems (Service Tips)	L0036B
In Tune with Power Harmonics	B0221A
The ABCs of DMMs	G0107D
Guide to High Performance DMMs	G0265B
Beat the Book, Auto-Electric Troubleshooting	B0164G

AVAILABLE THROUGH DISTRIBUTORS

All Accessories have a full 1 year warranty

Compatibility Charts

Accessory Compatibility Chart (continued)

		Handheld				Bench/System	System Multimeters	
Model Number	**Item**	**PM 2518**	**PM 2618**	**PM 2718**	**PM 2618/mAs**	**PM 2525**	**PM 2534**	**PM 2535**
Test Leads								
PM 9264/01	4-Wire Test Leads	—	—	—	—	Δ	Δ	Δ
PM 9265/01	Measuring Cable	—	—	—	—		Δ	Δ
PM 9266/03	Pair of Safety Test Leads	•	•	•	•	•	•	•
Probes								
PM 9210	HF. Probe	Δ	Δ	Δ	Δ	Δ	Δ	Δ
PM 9212	Accessory Set for PM 9210	Δ	Δ	Δ	Δ	Δ	Δ	Δ
PM 9246/04	30 kV Probe	Δ	Δ	Δ	Δ	Δ	Δ	Δ
PM 9249/01	Temperature Probe	Δ	Δ	Δ	Δ	Δ	Δ	Δ
PM 9267/01	Hold Probe	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Adapters (See Section 19)								
PM 9051	Adapter BNC (m)-Banana (f)	•	Δ	Δ	•	•	•	•
PM 9061	Adapter BNC (f)-BNC (f)	Δ	Δ	Δ	Δ	Δ	Δ	Δ
PM 9067	T-Piece BNC (1 x m, 2 x f)	Δ	Δ	Δ	Δ	Δ	Δ	Δ
PM 9218A/013	Power Line Adapter (110V)	Δ	Δ	Δ	Δ			
Current Accessories								
PM 9244	30A Shunt	Δ	Δ	Δ	Δ	Δ	Δ	Δ
PM 9245	100A Transformer	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Cases								
PM 9278/02	Ever-Ready Case	Δ	Δ	Δ	Δ	—	—	—
Cables (See Section 19)								
PM 9071	Banana-Banana 135 Ohm	Δ	Δ	Δ	Δ	Δ	Δ	Δ
PM 9072	Banana-BNC 135 Ohm	Δ	Δ	Δ	Δ	Δ	Δ	Δ
PM 9074	BNC-BNC 50 Ohm	•	•	•	•	•	•	•
PM 9075	BNC-BNC 75 Ohm	•	•	•	•	•	•	•
Interfaces								
PM 9190/02	RS-232/V-24	—	—	—	—	—	Δ	Δ
PM 9193/02	Analog Output	—	—	—	—	—	Δ	Δ
Rack Mounts (See Section 19)								
PM 9280/04	(2E High) 19" Rack Mount Kit	—	—	—	—		Δ	Δ
HM 9606/00	1x Counter + 1x Meter	—	—	—	—	Δ	Δ	Δ
HM 9606/02	1x Meter	—	—	—	—	Δ	Δ	Δ
PM 2193/02	3E Rack Mount Kit	—	—	—	—	Δ		

- • *Included in delivery*
- Δ *Optional*
- — *Not compatible, not recommended, or not applicable*

Interchangeable Test Lead Accessories

The best meter in the world is no good if you can't make a proper test connection.

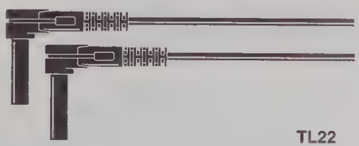
This group of interchangeable test lead accessories allows you to match a wide variety of clips and probes to make the most dependable test connections possible for your application. Built to the same high standards as the Fluke line of DMMs, these leads, clips and probes can withstand the rigors of daily use, and still make strong test connections time after time.

TL24 and TL22 Interchangeable Test Leads

- 385 internal strands and superior strain relief provide flexibility to prevent kinks and bends in test leads.
- Silicone-insulated; won't crack from cold or melt from accidental contact with soldering iron.
- Safety-designed with double insulation for added protection.
- All metal on banana plugs is capped and shrouded to prevent accidental contact.
- Compatible with all meters accepting safety-shrouded standard sized banana plugs.

Test Probes and Clips

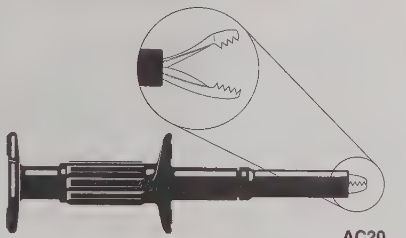
- Made from a combination of high quality steel and Polyamid plastic bodies for exceptional durability.
- Safety grip clips keep your hand a safe distance from test connections and easy to use even when wearing gloves.


TL22

TL22[1] Flexible Test Leads

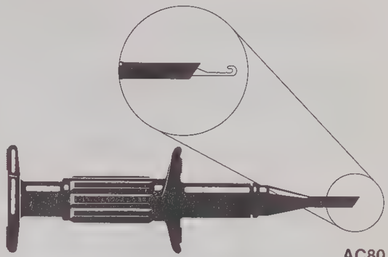
Interchangeable test leads connect to a wide variety of clips and probes. Extreme flexibility combined with superior strain relief. Heat and cold resistant, silicone-insulated, usable from -80°C to +150°C (-112°F to 302°F). Withstands short exposure to soldering irons. Good chemical resistance. Extra-long length of 63" (1.6m) and shrouded right-angle connectors on both ends. Set of one red and one black. Maximum voltage of 1000V[4], maximum current of 10A. Compatible with all DMMs that accept safety-shrouded inputs.

Recommended with AC20, AC80, AC83 and AC89


AC20

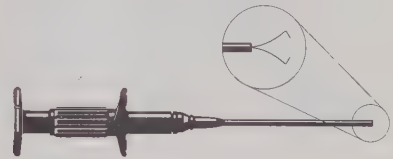
AC20[1] Industrial Test Clips

Safety-grip, spring-loaded alligator clips with a wide $^{3}/_{4}$" (19 mm) jaw opening. Maximum voltage of 1000V[4], maximum current of 10A. Easy to use while wearing high-voltage gloves. Set of one red and one black. Recommended for use with TL22 test leads. Compatible with all right-angle test leads having standard .160" (4 mm) diameter banana plugs, with or without safety shrouding.


AC80

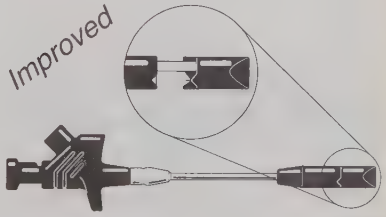
AC80[1] Hook-Style Test Clips

Set of safety-grip, spring-loaded clips with hook grip. Beryllium-copper hook size is .400" x .080" (10 mm x 2 mm). Maximum voltage of 1000V[4], maximum current of 3A. Set of one red and one black. Compatible with all test leads having standard diameter banana plugs, with or without safety shrouding.


AC83

AC83[1] Pin-Grabber Test Clips

Safety-grip, spring-loaded, pin-grabber hooks for use with test points in deep seated areas. Flexible shaft length is 4" (100 mm) and grabber extends $^{3}/_{8}$" (9.5 mm). Maximum voltage of 1000V[4], maximum current of 1A. Set of one red and one black. Banana jack compatible with all test leads having standard diameter banana plugs, with or without shrouding.


Improved

AC89

AC89 Insulation Piercing Clip

Pierces insulated wires for otherwise inaccessible test points. Clamp-type test clip has spring-loaded stainless steel tip. Pierces insulated wires from 30 AWG (.25 mm^2) to 14 AWG (1.5 mm^2). **Maximum voltage of 250V**, maximum current of 5A. For use only with test leads having shrouded, standard diameter banana plugs.

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[1] Listed to UL Safety Standards UL1244
[2] Factory Mutual Approved
[3] UL recognized
[4] Heavy Industrial Rating, Overvoltage Category III (CAT III) per IEC 1010-1

All Accessories have a full 1 year warranty.

Test Leads, Probes & Clips

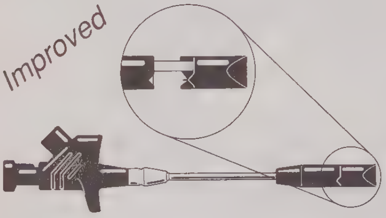
TL24

TL24[1] Flexible Test Leads

Same as TL22s except that one end has a shrouded, straight connector. Set of one red and one black. Maximum voltage 1000V[4], maximum current of 10A.

Recommended with AC89, AC85A, TP20, TP22 and TP80

Improved



AC89

AC89 Insulation Piercing Clip

Pierces insulated wires for otherwise inaccessible test points. Clamp-type test clip has spring-loaded stainless steel tip. Pierces insulated wires from 30 AWG (.25 mm^2) to 14 AWG (1.5 mm^2). **Maximum voltage of 250V**, maximum current of 5A. For use only with test leads having shrouded, standard diameter banana plugs.

NEW

AC85A

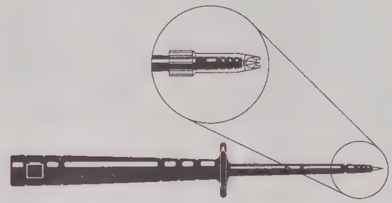
AC85A[1] Large Jaw Alligator Clips

Fully insulated, alligator clip with large 3/4" (20 mm) jaw opening. Other end is a standard banana jack. Extra strong teeth and new spring design provide superior grip. Extremely rugged. Recommended for use with automotive, marine, aviation, electrical and HVAC applications. **Maximum voltage of 600V**[4]. Maximum current of 10A. Set of one red and one black. Compatible with all test leads having standard diameter banana plugs, with or without safety shrouding.

TP20

TP20[1] Industrial Test Probes

Safety-designed, test probe with very sharp, extra-long, .750" (19 mm) stainless steel tip for reaching deep test points or recessed component leads. Also suitable for piercing insulation. Finger guard protection with non-roll feature. Maximum voltage of 1000V[4], and maximum current of 10A. Set of one red and one black. Compatible with all test leads having standard diameter banana plugs, with or without safety shrouding.



TP80

TP80 Electronic Test Probes

Designed for electronic probing of high density components or boards. IC insulator cap prevents shorting of adjacent IC legs. Test probe has a tapered .160" (4 mm) steel tip. Maximum voltage of 1000V, maximum current of 10A. Set of one red and one black. Compatible with all test leads having standard diameter banana plugs, with or without safety shrouding.

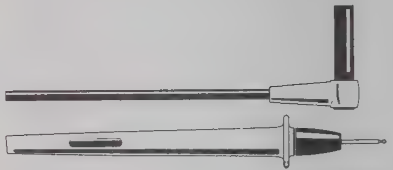
NEW

AC70A

AC70A Alligator Clips

Package of two insulated alligator clips with gold-plated beryllium copper spring contacts. Accepts wide range of probe diameters from 0.076" to 0.084" (1.93 mm to 2.13 mm). Maximum voltage of 1000V, maximum current of 10A. Standard .313" (8 mm) jaw opening. One red and one black. Compatible with TL70A, TL75, Y8140, and other standard point probes.

Recommended with TL70A and TL75



TL70A

TL70A[1] Right-Angle Test Lead Set

Comfort-grip probe with PVC-insulated leads, and new integral strain relief. Recommended for high-resolution meters (with 4 1/2 digit displays) and for µV measurements. Safety-shrouded, right-angle inputs. 48" (1.2m). 1500V, 10A. **Replaces TL70.**

TL75

TL75[1] Hard Point™ Test Lead Set

Comfort-grip probe with PVC-insulated leads. Super strong tips and new integral strain relief provide extended service life. Safety-shrouded, right-angled inputs. Not recommended for µV measurements. 48" (1.2m). 1500V, 10A. **Replaces TL70.**

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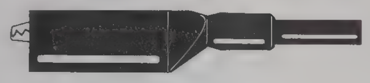
[1] *Listed to UL Safety Standards UL1244*

[2] *Factory Mutual Approved*

[3] *UL recognized*

[4] *Heavy Industrial Rating, Overvoltage Category III (CAT III) per IEC 1010-1*

All Accessories have a full 1 year warranty.

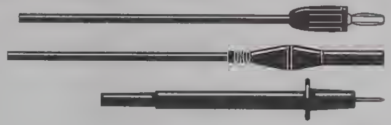


AC75

AC75 Banana Jack – Alligator Clips

Package of four, insulated, alligator clips with banana jacks. Standard 5/16" (8 mm) jaw opening. Two red and two black. Compatible with test leads Y8131 through Y8134 plus the TL24. Maximum voltage of 1000V, maximum current of 10A.

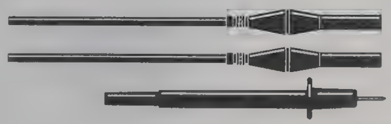
Recommended with Y8131 and Y8132



Y8131

Y8131[1] Replacement Test Lead Set

Four-foot (1.2m) test leads feature exposed banana plugs on one end and detachable probes with solid pin tips and finger guards on other end. Maximum voltage of 2000V, maximum current of 10A. Compatible with AC75 Alligator Clips. See Selection Guide for compatible DMMs.



Y8132

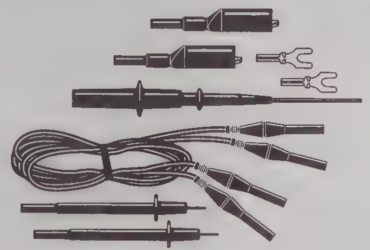
Y8132[1] Replacement Test Lead Set

Same as Y8131 except straight, shrouded banana plugs are on both ends. See Selection Guide for compatible DMMs.

Test Lead Kits & Sets

Y8133[2] Standard Test Lead Kit

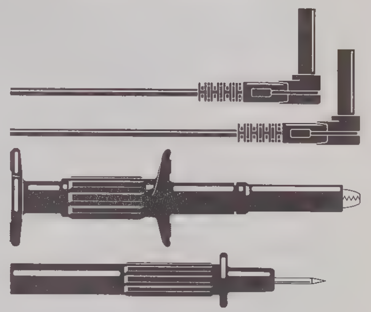
Y8133 (not shown, similar to Y8134) includes a black and a red insulated wire lead each having an exposed banana plug on one end and a safety-designed, shrouded banana plug on the other. Also included are two insulated alligator clips, two spade lug tips, a spring-loaded hook tip, and two probes with solid metal pin tips, finger guards, and pouch. Any of the clips, tips, and probes may be plugged onto the shrouded banana plug on either wire lead. Maximum voltage of 2000V, maximum current of 10A. See Selection Guide for compatible DMMs.



Y8134

Y8134 Shrouded Test Lead Kit

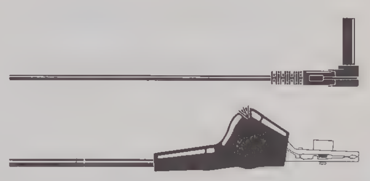
Same as Y8133 Test Lead Kit except banana plugs are shrouded by an insulating shield on both ends of each lead. Maximum voltage of 2000V, maximum current of 10A. See Selection Guide for compatible DMMs.



TL20

TL20[1] Industrial Test Lead Set

Set consists of TL22 63" (1.6m) silicone-insulated test leads that remain flexible from -80°C to +150°C (-112°F to +302°F). Leads have shrouded right-angle connections. Also includes TP20 interchangeable stainless steel test probes and AC20 safety alligator clips. Maximum voltage of 1000V[4], maximum current of 10A. See Selection Guide for compatible DMMs.



TL26

TL26 5-Way Multipoint Test Lead Set

Industry-standard test lead set for telecom and automotive applications. The multi-purpose test clip on these test leads allows 5-ways to connect to a device under test. 1) Has a U-shaped nose for blade-shaped terminals. 2) Notched jaw for gripping screw heads, bare wire, or terminals. 3) Serated teeth for gripping threaded or wire-wrapped terminals. 4) Cluster of sharp needles for piercing small guage (#22-28 AWG) wires. 5) Large piercing needle for penetrating larger guage wires. Set of one red and one black. **Rated for 250V** and 10A. Silicone-insulated test leads are heat-resistant and remain flexible from -80°C to +150°C (-112°F to +302°F). Length of leads is 60" (1.52m). Right angle banana plug on one end is compatible with all DMMs that accept safety-shrouded inputs.

All Accessories have a full 1 year warranty.

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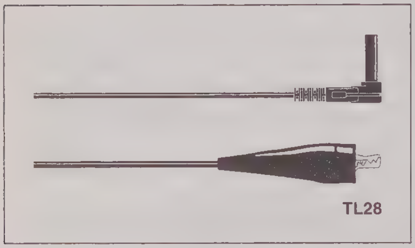
[1] Listed to UL Safety Standards UL1244
[2] Factory Mutual Approved
[3] UL recognized
[4] Heavy Industrial Rating, Overvoltage Category III (CAT III) per IEC 1010-1

Test Leads, Probes & Clips/Current Accessories


TL28

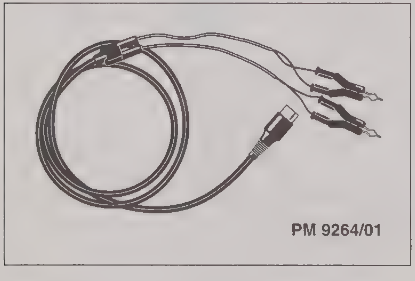
TL28 2-Way Clip Test Lead Set

These test leads have solid, spring-loaded copper clips with a wide 1/2" jaw opening and serated teeth for gripping threaded or wire-wrapped terminals. Also has a large piercing needle for penetrating larger guage wires. **Rated for 250V** and 10A. Recommended for use with automotive, marine, aviation, and low-voltage industrial circuits. Set of one red and one black. Silicone-insulated test leads are heat-resistant and remain flexible from -80°C to +150°C (-112°F to +302°F). 60" (1.52m) test lead length. Shrouded right-angle connector on one end is compatible with all DMMs that accept safety-shrouded inputs.

Y8140

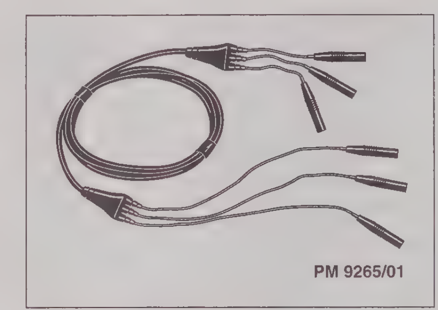
Y8140[2] Test Lead Set

Slim, retractable, insulated, needle-point tips adjust to desired length. Tough, thin insulation extends all the way to the points to prevent shorting adjacent components or conductors. Needle points easily pierce varnish and thin insulation to give good electrical contact. Four-feet (1.2m) long. Exposed banana plugs. Maximum voltage of 1000V, maximum current of 2A. See Selection Guide for compatible DMMs.


PM 9264/01

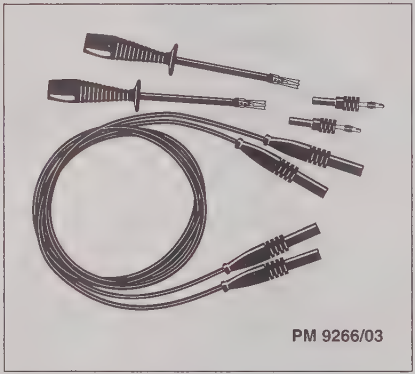
PM 9264/01 4-Wire Test Leads/Clips

4-wire test lead for resistance measurements. One side with 5-pole DIN connector and one side with Kelvin clips. See Selection Guide for compatible DMMs.


PM 9265/01

PM 9265/01 Shielded 3-Wire Test Lead

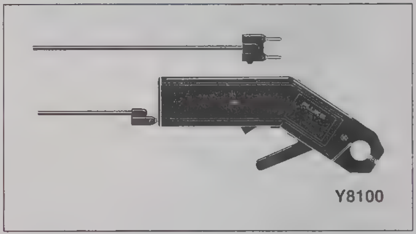
Safety-designed, shielded 3-wire test lead 3 feet (1m) long. See Selection Guide for compatible DMMs.


PM 9266/03

PM 9266/03 Test Lead Set

Three-foot safety designed silicon insulated test leads (UL-Approved) with detachable probes and adapters to "non-safety" 4 mm banana plugs. See Selection Guide for compatible DMMs.

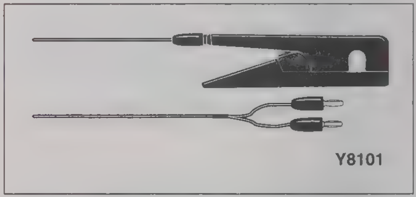
Current Probes


Y8100

Y8100[2] Clamp-on DC or AC Current Probe

The Model Y8100 is a clamp-on, Hall-effect probe that can be used with a voltmeter, multimeter, or oscilloscope to read dc, ac, or composite (ac/dc) current measurements. The pistol shape allows safe, easy, one-hand operation when making current measurements. Two ranges, 20A and 200A, produce a 2V output at full range current. The probe battery-low indicator light lets the operator know when the battery voltage is too low for proper operation.

Ranges: 20A ac or dc and 200A ac or dc
Accuracy: DC to 200 Hz, ±2% of range; 200 Hz to 1 kHz, below 100A add ±3% of reading; 200 Hz to 1 kHz, above 100A add ±6% of reading
Working Voltage: Core to output; 600V dc or 480V ac maximum; output to ground; 42V dc or 30V ac maximum
Maximum Conductor Size: 1.9 cm (.75 in)


Y8101

Y8101[2] Clamp-on AC Current Probe

The Y8101 is a small clamp-on current transformer designed to extend the current measuring capability of a DMM or ac current meter up to 150 amperes. The coil on the clamp-on core serves as the secondary of a 1000:1 ratio transformer. The current-carrying conductor being measured serves as the primary.

Current Range: 2A to 150A
Accuracy: ±(2.5% of reading + 0.15A), 48 Hz to 440 Hz; ±(3% of reading + 0.15A), 440 Hz to 1200 Hz
Division Ratio: 1000:1
Working Voltage: 300V ac rms maximum
Maximum Conductor Size: 1.11 cm (0.43 in)
Usable Current Range: 0.1A to 200A, 5 seconds maximum above 150A

All Accessories have a full 1 year warranty.

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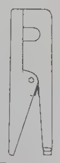
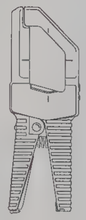
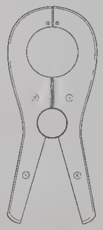
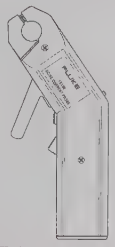
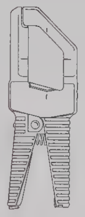
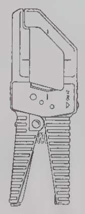
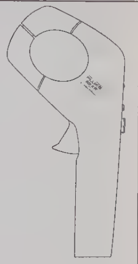
[1] *Listed to UL Safety Standards UL1244*
[2] *Factory Mutual Approved*
[3] *UL recognized*
[4] *Heavy Industrial Rating, Overvoltage Category III (CAT III) per IEC 1010-1*

Power/Current Clamp Selection Guide

	AC Only Models			AC or DC Models			AC/DC Power
							
Model	**Y8101**	**80i-400**	**80i-600**	**Y8100**	**80i-410**	**80i-1010**	**80i-kW**
Construction							
Material	ABS	Rugged, glass filled polycarbonate	ABS nickel iron core	ABS	Rugged, glass filled polycarbonate	Rugged, glass filled polycarbonate	ABS
Type	Current Transformer 1000:1	Current Transformer 1000:1	Current Transformer 1000:1	Hall sensor	Hall sensor	Dual Hall sensor	Dual Hall sensor
Jaw Size Maximum Conductor Size THHN	#2 AWG	*750 MCM or 2 x 500 MCM 2.5" x 0.2" Bus Bar	1000 MCM	250 MCM	*750 MCM or 2 x 500 MCM 2.5" x 0.2" Bus Bar	750 MCM or 2 x 500 MCM 2.5" x 0.2" Bus Bar	1000 MCM or 2 x 500 MCM 2.5" x 0.2" Bus Bar
Diameter	1.11 cm (.43")	3.3 cm (1.25")	5 cm (2.0")	1.9 cm (.75")	3.3 cm (1.25")	3.3 cm (1.25")	6 cm (2.38") x 7.3 cm (2.87") oval
AC							
Lowest Current	2A ±0.175A	1A ±0.43A (Useable to 0.1A)	Best 1A ±0.02A (Useable to 0.1A)	1A ±0.4A	5A ±2.75A (Useable to 2A)	1A ±1A	1A ±2A
Highest Current	150A ±3.9A	400A ±12.4A (600A for 5 sec.)	Best 600A ±12A (2000A for 5 sec.)	200A ±4A	400A ±22.5A (Useable to 600A)	700A ±21A	1000A ±60A
Best AC Accuracy (mid band & mid range)	±(2.5% of reading + 0.15A)	±(3% of reading + 0.4A)	±2% reading	±2% range	±(5% of reading + 2.5A)	±(2% of reading + 1A)	±(2% of reading + 2A)
Frequency Response (-3 dB typical)	10 kHz	5 kHz	10 kHz	1 kHz	1.2 kHz	6 kHz	3.2 kHz
DC							
DC Range	NA	NA	NA	1-20A, 10-200A	5-400A	1 to 1000A	1 to 1300A
Best DC Accuracy	NA	NA	NA	Best low range ±2% of range	±(5%+2.5A)	±(2%+1A)	Best high range ±(2%+2A)
Zero Error Adjustment	NA	NA	NA	Yes–Thumbwheel	No	Yes–Thumbwheel	Yes–Knob
General							
Electrical Noise Immunity	Good	Good	Good	Average	Not Recommended	Not Recommended	Not Recommended
Working Voltage	300V	660V	750V	480V	660V	660V	660V
Battery Life (typical)	NA	NA	NA	20 hrs.	600 hrs.	200 hrs.	100 hrs.

** Measurement accuracy affected by conductor position in jaw.*
Note: Current clamps must be used with true-rms multimeters such as Fluke 87, 8060A and 8062A or 8026B, to make true-rms measurements.

All Accessories have a full 1 year warranty.

Current Accessories

Current Accessory Selection Tips

Current probes are available in two different types, current transformers (CTs) and Hall-effect units. The CTs include models Y8101, 80i-400, and 80i-600. These probes measure ac current only. The Hall-effect units include models Y8100, 80i-410, 80i-1010, and 80i-kW. They measure both dc and ac current.

AC Current Clamps: Current Transformers (CTs)

For all Fluke CT's, the transformer turns ratio is 1:1000, i.e. the primary current being measured in amps is divided down into milliamps on the probe's secondary output. The probe's output cable connects to the multimeter's milliamp ac input terminals, allowing the multimeter to display the reading directly in amps with correct decimal up to the multimeter's maximum range value. The primary current waveshape is repeated on the secondary output (within the probe's bandwidth limitations). TRUE rms measurements require a TRUE rms multimeter.

The CTs are rugged and reliable because they don't contain switches or batteries. Since they contain no circuitry, they are recommended for applications in environments where electrical noise can be a problem. CT's are compatible with all Fluke handheld multimeters except the Fluke 70, 73, and all Series 10 meters. Note that with the Fluke 29 and 79, above 40A, resolution is limited to 1 amp.

DC/AC Current Clamps: Hall Effect Probes

These probes employ a Hall-effect semiconductor connected to a battery-powered amplifier circuit which can measure ac, dc, or ac+dc current. The output signal for models 80i-410, 80i-1010, and 80i-kW is 1 millivolt per amp. Model Y8100 has an output of 2V full scale, requiring you to mentally move the decimal on the display to obtain the correct reading. The output voltage waveshape follows the waveshape of the current being measured (within the probe's bandwidth limitations). If a TRUE rms measurement is required, then a TRUE rms multimeter must be used.

These probes connect to the voltage input of the multimeter. The Hall-effect probes which have outputs of 1 mV/amp are used in conjunction with the multimeter's dc millivolt range when measuring dc current. This allows the multimeter to read directly in dc amps with correct decimal for readings within the dc millivolt range. All Fluke handheld multimeters in this catalog have a dc millivolt range. However, all Series 10 meters are limited to 1 amp of resolution for ac readings.

Measuring ac current with a Hall-effect probe is similar except that the multimeter is set for ac millivolts; provided the multimeter is equipped with that range. Note that multimeter models 21, 23, 29 and the 70 Series do not have a millivolt ac range and therefore would be set for volts ac. This setting will have less resolution and accuracy for low current reading. In addition, it will require the operator to mentally shift the decimal in the multimeter display. Also notice that all Series 10 meters are limited to 1 amp of resolution for ac readings.

Note that multimeter models 8060A, 8062A, and 87 have a lower limit to specified accuracy when using a Hall-effect probe in conjunction with the millivolt ac range. See the Accessory Compatibility Chart on page 134 for specifics. Hall-effect probe model Y8100 (output of 2V full scale) requires the operator to mentally shift the decimal for either ac or dc current measurements.

Summary

For measuring ac current only, CTs are preferred. CT probes are recommended for measuring ac current of variable speed motors. For dc measurements choose a Hall-effect unit. If you want to measure ac current with a Hall-effect probe, choose a multimeter with an ac millivolt range. Choose a TRUE rms multimeter if you need to make TRUE rms measurements.

Harmonics

Non-linear electrical loads cause distorted currents and voltages which generate harmonics that are multiples of the fundamental frequency. Examples of these loads include computers and adjustable speed drives that draw current in abrupt pulses rather than in a linear manner.

Harmonics may cause dangerous heating of transformers, neutral conductors, and motors, as well as premature tripping of circuit breakers.

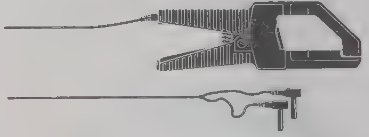
High accuracy true-rms meters with wide bandwidth ac current clamps are required to obtain correct measurements on circuits containing harmonics. A traditional "average responding" meter will give inaccurate readings that may be up to 50% low when used circuits with harmonics.

The following products from Fluke are recommended to help detect and measure circuits that may contain harmonics:

- Fluke 87 True-rms DMM and 80i-600 or 80i-400 AC Current Clamp

or

- Fluke 31 or 33 True-rms Clamp Meters



80i-400

80i-400 Clamp-on AC Current Probe

The Model 80i-400 is a clamp-on current probe designed to extend the current capability of an ac current meter to 400 amperes. A clamp-on, 1000-turn coil designed into the probe allows measurements to be made without breaking the circuit under test. The current carrying conductor being measured serves as the primary. The unique shape of the 80i-400 jaw will accommodate a single 750 MCM THHN (30 mm diameter) conductor or two 500 MCM THHN (25 mm diameter each) conductors run in parallel.

Current Range: 1A to 400A
Accuracy: ±(3% of reading +0.4A), 48 Hz to 440 Hz; ±(4% of reading +0.4A), 440 Hz to 1000 Hz
Division Ratio: 1000:1
Working Voltage: 660V ac rms maximum
Maximum Conductor Size: 1 ea 30 mm (1.18 in) or 2 ea 25 mm (0.98 in)
Usable Current Range: 0.1A to 600A, 5 seconds maximum above 400A

80i-410

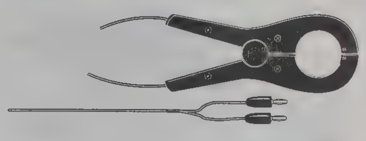
80i-410 Clamp-on DC/AC Current Probe

The Model 80i-410 ac/dc current probe extends the ac or dc capacity to 400 amps. This Hall-effect probe is relatively insensitive to conductor position within the jaws for good repeatability. Physical dimensions are identical to 80i-400 and will accommodate similar conductors. Output signal 1 mV per amp.

Specified Current Range: 5A to 400A ac or dc
Usable Current Range: 2A to 600A ac or dc
Accuracy: ±(5% + 2.5A) dc to 62 Hz
Working Voltage: 660V rms
Maximum Conductor Size: 1 ea 30 mm (1.18 in) or 2 ea 25 mm (0.98 in)

[1] Listed to UL Safety Standards UL1244
[2] Factory Mutual Approved
[3] UL recognized
[4] Heavy Industrial Rating, Overvoltage Category III (CAT III) per IEC 1010-1

All Accessories have a full 1 year warranty.



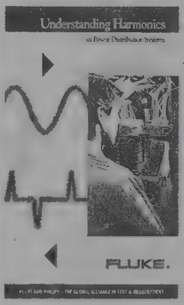
80i-600

80i-600[2] Clamp-on AC Current Probe

The Model 80i-600 is a clamp-on current transformer designed to extend the current measuring capability of a DMM or current meter to 600 amperes. A coil on the clamp-on transformer core allows measurements to be made without breaking the circuit under test. This coil serves as the secondary of a 1000:1 transformer. The current-carrying conductor being measured serves as the primary. Because of a high efficiency, evenly distributed winding, wire size and location of the wire within the transformer jaws will not affect the accuracy of current measurements.

Current Range: 1A to 600A
Accuracy: ±(2% of reading), 50 Hz to 1 kHz; ±(3% of reading) typical, 30 Hz to 50 Hz or 1 kHz to 10 kHz
Division Ratio: 1000:1
Working Voltage: 750V ac rms maximum
Maximum Conductor Size: 5 cm (2 in)
Usable Current Range: 0.1A to 2000A, 5 seconds maximum above 600A

New Training Video*



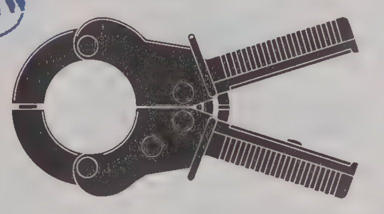
Understanding Harmonics in Power Distribution Systems. This informative video provides a basic understanding of power system current harmonics. It includes numerous diagrams and formulas that will take the mystery out of harmonics troubleshooting. Its straight forward hands-on approach will help you solve many of your most troubling electrical problems.

Specific Topics Include:
- Definition and classification of harmonics.
- Understanding electrical load types.
- Electrical equivalent circuits.
- Finding harmonics.
- Solution and prevention of harmonic problems in new and existing facilities.
- Test equipment requirements for harmonic troubleshooting.

This video can be purchased through your local Fluke distributor or by calling 1-800-526-4731. Ask for part # 926993

*Available in U.S. & Canada only

NEW



80i-1000s

80i-1000s AC Current Probe for Oscilloscopes

The Model 80i-1000s expands oscilloscope applications for testing industrial and commercial electrical power distribution systems. It is ideal for measuring distorted current waveforms and power line harmonics without breaking into the circuit.

For maximum utility, the 80i-1000s offers accurate measurements over a wide range of current amplitudes and frequency. Three output scalings (switch selectable) provide maximum resolution on your oscilloscope display. A passive filter eliminates noise and ring on rapidly rising waveforms, ensuring accurate display on your oscilloscope.

The 80i-1000s is designed for safety on electrical systems up to 600V[4] ac rms. Double insulated construction in the jaws and handle, as well as reinforced insulation on the output cable and connector provide safety not found on similar probes.

When used with the Fluke ScopeMeter, it allows simultaneous measurement of current and voltage. Waveforms may be recorded for later display, analysis and report generation.

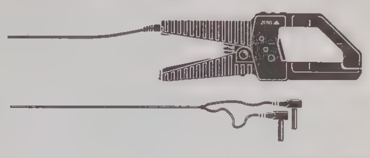
Current Measurement: 0.1A to 1000A rms ac
Basic Accuracy: 2% of reading for 1 and 10 mV/A ranges, 3% ±100 mA for 100 mV/A range. 45 Hz to 1 kHz.

Scaling

Switch Position	Current Range (instantaneous peak)
1 mV/Amp	5A to 1000A (2000A)
10 mV/Amp	500 mA to 100A (200A)
100 mV/Amp	100 mA to 10A (20A)

Working Voltage: 600V
Float Voltage: 600V
Usable Frequency Range: 5 Hz and 100 kHz
Maximum Conductor Size: 54 mm (2.13 in)

All Accessories have a full 1 year warranty.



80i-1010

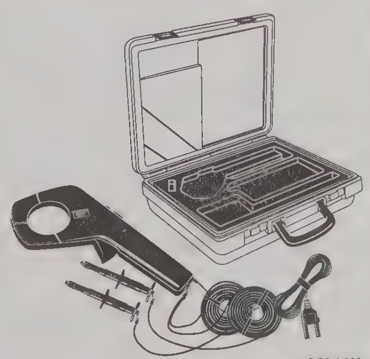
80i-1010 Clamp-on DC/AC Current Probe

The 80i-1010 is a battery powered clamp-on current probe that is used with a voltmeter to measure dc currents up to 1000 amps or ac currents up to 700 amps. The jaws will accommodate a single 750 MCM THHN or two 500 MCM THHN conductors. A convenient thumbwheel ZERO control improves accuracy of dc currents down to 1 amp. Typical frequency response is -3 dB at 6 kHz.

Specified Current Range: 1A to 1000A dc, 1A to 700A ac
Accuracy: (% of reading)

Range	DC	AC, 48 to 62 Hz	AC, 62 to 440 Hz
1A to 100A	2% + 1A	2% + 1A	3% + 1A
100A to 700A	3%	3%	5%
700A to 1000A	5%	Not specified	

Output Signal: 1 mV per amp dc or ac
Working Voltage: 660V rms maximum
Maximum Conductor Size: 1 ea 30 mm (1.18 in) or 2 ea 25 mm (0.98 in)



80i-kW

80i-kW Current/Power Probe

- Measures ac and dc current, and true power (kW)
- Wide Range: 1300A dc, 1000A ac, 330 kW ac
- Large oval jaw: 2$^{7}/_{8}$" x 2$^{3}/_{8}$" (73 mm x 60 mm)
- Thumbwheel zero control for accurate dc measurements

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[1] Listed to UL Safety Standards UL1244
[2] Factory Mutual Approved
[3] UL recognized
[4] Heavy Industrial Rating, Overvoltage Category III (CAT III) per IEC 1010-1

Current, & Temperature Accessories

- Output signal of 1 mV per amp or 1 mV per kW
- Frequency response of 3.2 kHz typical
- Measures true ac power for both sine waves and non-sinusoidal waveforms
- Supplied with special safety designed voltage test leads and detachable safety alligator clips
- Includes ruggedized hard carrying case with compartments for DMM and accessories
- Includes instructions for 3-phase power measurements and power factor calculations

The Fluke 80i-kW Current/Power Probe is a battery-powered clamp-on multimeter accessory that measures dc current, ac current and true ac power (kW) without breaking the circuit. The 80i-kW uses special safety-shrouded voltage test leads with safety alligator clips to provide a voltage input that, in conjunction with the current input, gives a reading in kilowatts on the multimeter.

In the current mode, the output voltage waveform follows the measured current waveform, up to the probe's bandwidth limit. This allows true-rms measurements of currents with harmonics when used with a true-rms multimeter. Since the output is voltage, the 80i-kW may be used with an oscilloscope. In the power mode, the output represents true power including the effects of phase angle distortion. The instruction manual describes methods of power measurement for both single-phase and 3-phase circuits. Examples of kVA and power factor calculations are also included.

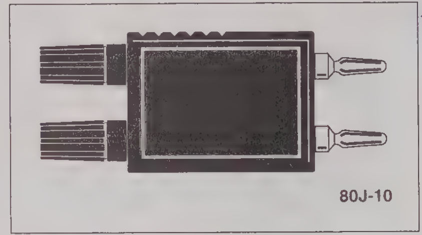
Specifications

DC Current
Range: 1A to 1300A dc
Accuracy (±% of reading, 1 year): 1A to 700A: 2% + 2A; 700A to 1000A: 3%; 1000A to 1300A: 4% typical

AC Current
Range: 1A to 1000A ac or ac + dc
Accuracy (±% of reading, 1 year):

	dc to 62 Hz	62 Hz to 440 Hz
1A to 500A	2% + 2A	6% + 2A
500A to 700A	3%	7%
700A to 1000A	6%	8% typical

AC Power
Range: 0.5 kW ac to 330 kW ac (90V ac to 660V ac, 1A to 500A ac)
Accuracy (±% of reading, 1 year):
48 Hz to 62 Hz: 3.5% + 0.5 kW (power factor -0.5 to +0.5); 390 Hz to 410 Hz: 4% + 0.5 kW (power factor -0.9 to +0.9)

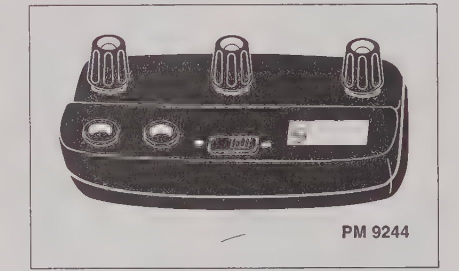


80J-10

80J-10 Current Shunt

An inexpensive, simple-to-use accessory that lets you measure ac or dc current using any sensitive voltmeter having banana jack inputs with a standard 3/4" spacing. Two 5-way binding posts become the current input terminals. The precision, .01Ω shunt resistor will pass 10 amperes continuously without overheating, or up to 20 amperes for one minute. Not compatible with Y8132, Y8134, TL70A or TL75 test lead sets.

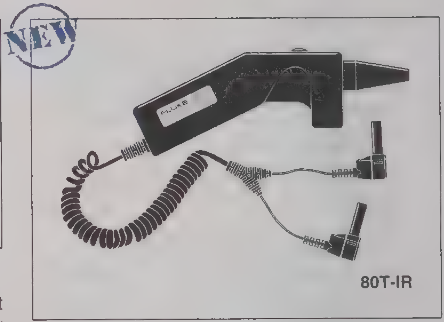
Sensitivity: 10 mV per ampere
Shunt Resistance: 0.01Ω
Accuracy: ±0.25%, from dc to 10 kHz, typically rising to 1 dB at 100 kHz
Series Inductance: 8.3 nH
Overload: <20A, not fused



PM 9244

PM 9244 AC & DC Current Shunt Max 31.6A

Current Ranges: 10A and 31.6A
Frequency Range: DC to 1 kHz
Output Voltage: 100 mV or 31.6 mV at full range
Accuracy: ±1% (100 mV range); ±2% (31.6 mV range)
Size: 140 mm W x 55 mm H x 65 mm D (5.5 in W x 2.2 in H x 2.6 in D)



80T-IR

80T-IR Infrared Temperature Probe

The Fluke 80T-IR Infrared Temperature Probe is a low cost, non-contact temperature measurement accessory designed to work with any digital multimeter. It converts infrared light emitted by an object into a 1 mV dc per °C or °F signal.

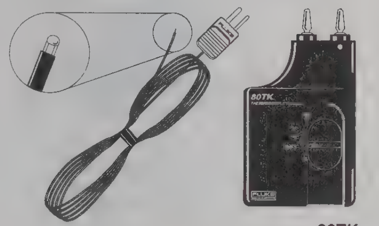
The infrared probe has a selection switch for direct reading of temperature in °C or °F on the digital multimeter display.

The output of the infrared probe may be read on any DMM having a 10 MΩ or greater input impedance, a 3-digit display, and accepting standard diameter shrouded banana plugs. It is powered by a standard 9V battery, with typical battery life of 50 hours. The probe features an automatic shut-off after 10 minutes of operation to save battery life.

Temperature Range: -18°C to 260°C or 0°F to 500°F
Accuracy: ±3% (+3 digits) of reading
Repeatability: ±1% of reading
Emissivity: Fixed at .95
Response Time: 1 second
Optical Resolution: 4 to 1 distance to spot size
Output: 1 mV per °C or °F (switchable)
Power: 9V alkaline battery
Battery Life: 50 hours (Automatic shut-off after 10 minutes)
Ambient Operating Temperature: 0°C to 65°C (32°F to 150°F)

All Accessories have a full 1 year warranty.

Temperature Accessories



80TK

80TK Thermocouple Module

The Fluke 80TK Thermocouple Module is a low cost temperature measurement accessory designed to work with any digital multimeter. It converts the microvolt output from a Type K thermocouple into a 1 millivolt per degree signal.

The on-off switch allows selection of degrees "C" or "F" output scaling. Input is via a "mini" thermocouple connector, with provision inside for hardwiring. **A bead thermocouple, with mini-connector attached, is included with the 80TK.** Immersion probes and surface probes are also available, as are additional bead probes.

The output of the 80TK may be read on any DMM having 10 Mohm or greater input impedance and a mV dc scale. It is powered by a standard 9V battery, with a typical operating life of 1600 hours. Battery condition can be checked on the DMM with battery test instructions printed on the 80TK.

Measurement Range: -50°C to 1000°C (-58°F to 1832°F)

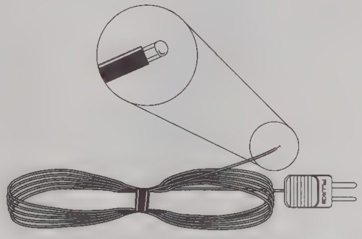
Ambient Operating Range: 0°C to 50°C, 32°F to 122°F

Accuracy

-50°C to -20°C 2.5% ±2°C -58°F to -5.8°F 2.5% ±3.6°F	350°C to 500°C 1.75% ±2°C 663°F to 932°F 1.75% ±3.6°F
-20°C to 350°C 0.5% ±2°C -4°F to 662°F 0.5% ±3.6°F	500°C to 1000°C 2.0%±2°C 933°F to 1832°F 2.0% ±3.6°F

All Accessories have a full 1 year warranty.

80TK Recommended with 80PK-1, 80PK-2A, 80PK-3A, 80PK-4A, 80PK-5A, and 80PK-6A



80PK-1

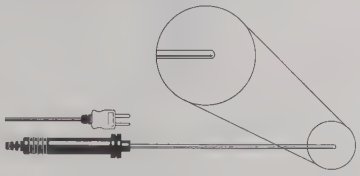
80PK-1 Type K Bead Probe

Included with 80TK, Fluke 50 Series. General purpose. Teflon tape insulation. Not suitable for liquids.

Measurement Range: -40°C to +260°C (-40°F to +500°F)

Accuracy (with respect to NIST tables): ±1.1°C (2.0°F) over the range of 0°C to 260°C (32°F to 500°F); typically within 1.1°C of NBS tables over the range of -40°C to 0°C (-40°F to 32°F)

Restrictions: Must be used in Teflon-compatible environments and is not suitable for liquid immersion. The 260°C (500°F) continuous temperature rating is primarily determined by the Teflon insulation.



80PK-2A

80PK-2A Type K Immersion Probe

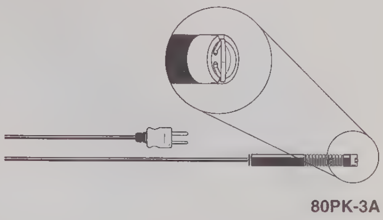
For liquids and gels. Protected from tip to handle by an Inconel sheath; suitable for most general purpose measurements.

Measurement Range: -196°C to +1090°C (-320°F to +1922°F)

Accuracy: (with respect to NIST tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±4% of Rdg
-110°C to -40°C (-166°F to -40°F)	±4.4°C (7.92°F)
-40°C to 275°C (-40°F to 527°F)	±2.2°C (3.96°F)
275°C to 1090°C (527°F to 1922°F)	±.0.75% of Rdg

Restrictions: The sheath material of the 80PK-2A is Inconel. It should not be used in the presence of sulfur above 537°C (1000°F).



80PK-3A

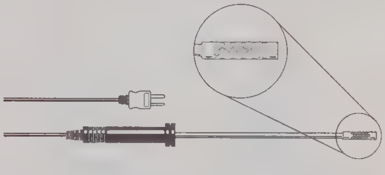
80PK-3A Type K Surface Probe

For flat or slightly convex surfaces. Ideal for measurement of hot rollers and plates.

Measurement Range: 0°C to +260°C (32°F to +500°F)

Accuracy (with respect to NIST tables): ±1.1°C (2.0°F) over the range of -28°C to +260°C (-18.4°F to 500°F)

Restrictions: The 260°C continuous temperature rating is primarily determined by the Teflon support piece. The Teflon insulation should not be exposed to temperatures exceeding 260°C (500°F) nor to open flame, since this can cause release of toxic material.



80PK-4A

80PK-4A Type K Air Probe

For air and gases. Measuring bead is protected by perforated Stainless Steel baffle. Not for immersion in liquid.

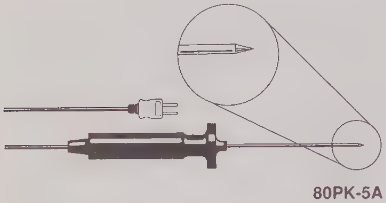
Measurement Range: -196°C to +816°C (-320°F to +1500°F)

Accuracy (with respect to NIST tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±4% of Rdg
-110°C to -40°C (-166°F to -40°F)	±4.4°C (7.92°F)
-40°C to 275°C (-40°F to 527°F)	±2.2°C (3.96°F)
275°C to 816°C (527°F to 1500°F)	±.0.75% of Rdg

Restrictions: The 304 stainless steel baffle should not be exposed to halides or sulfides.

Temperature Accessories



80PK-5A

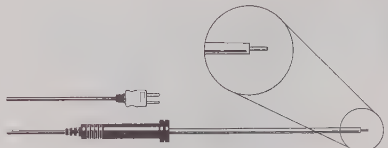
80PK-5A Type K Piercing Probe

Made of 316 Stainless Steel suitable for food service. Also suitable for liquids and gels.

Measurement Range: -196°C to +816°C (-320°F to +1500°F)
Accuracy (with respect to NIST tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±4% of Rdg
-110°C to -40°C (-166°F to -40°F)	±4.4°C (7.92°F)
-40°C to 275°C (-40°F to 527°F)	±2.2°C (3.96°F)
275°C to 816°C (527°F to 1500°F)	±.0.75% of Rdg

Restrictions: The sheath material of the 80PK-5A is 316 stainless steel. It should not be exposed to halides or sulfides.



80PK-6A

80PK-6A Type K Exposed Junction Probe

Exposed bead attached to 6" sheath for general purpose and air or gas measurements.

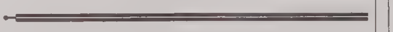
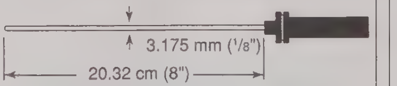
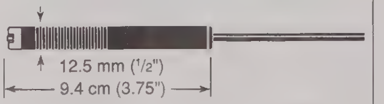
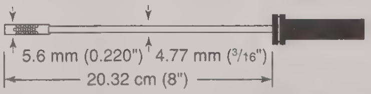
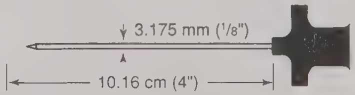
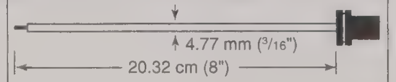
Measurement Range: -196°C to +816°C (-320°F to +1500°F)
Accuracy (with respect to NIST tables)

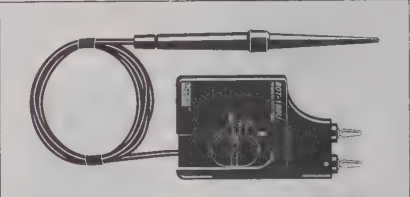
Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±4% of Rdg
-110°C to -40°C (-166°F to -40°F)	±4.4°C (7.92°F)
-40°C to 275°C (-40°F to 527°F)	±2.2°C (3.96°F)
275°C to 816°C (527°F to 1500°F)	±.0.75% of Rdg

Restrictions: The sheath material is 304 stainless steel. It should not be exposed to halides or sulfides. In addition, the probe should not be used in reducing atmospheres or a vacuum.*

** Because of the open access to the inside of the sheath via the exposed bead, the probe must not be immersed in liquid or saturated vapor. Immersion of the probe in liquid or saturated vapor could result in "wicking" of the substance, and possible corrosion.*

Type-K, Thermocouples

Model	Range	Maximum Temperature of:	Style (cable length: 1.2m (4 ft))
80PK-1	-40°C to 260°C (-40°F to 500°F)	Insulation: 260°C (500°F)	
80PK-2A	-196°C to 1090°C (-320°F to 1922°F)	Cable: 105°C (220°F) Handle: 125°C (257°F)	
80PK-3A	0°C to 260°C (32°F to 500°F)	Cable: 105°C (220°F) Handle: 260°C (500°F)	
80PK-4A	-196°C to 816°C (-320°F to 1500°F)	Cable: 105°C (220°F) Handle: 125°C (257°F)	
80PK-5A	-196°C to +816°C (-320°F to 1500°F)	Cable: 105°C (220°F) Handle: 65°C (150°F)	
80PK-6A	-196°C to +816°C (-320°F to 1500°F)	Cable: 105°C (220°F) Handle: 125°C (257°F)	



80T-150U

80T-150U Temperature Probe

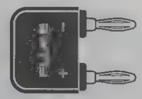
The 80T-150 is a high accuracy universal temperature probe designed to provide virtually all DMMs with temperature measuring capability. Intended for air, surface, and non-corrosive liquids, the probe provides direct temperature conversion of 1 mV dc per degree. A three-position switch on the unit acts as a power switch and is used for selecting Celsius or Fahrenheit scaling for the output. In addition, the OFF position of the power switch allows the battery condition to be determined via the external DMM. Operating power for the 80T-150U is derived from a standard 9 volt battery. Typically, the battery provides more than 1600 hours of continuous operation before replacement is necessary. An outstanding feature of particular importance to electronically-oriented users is the probe's ability to stand off voltages to 350V dc or peak ac. This allows voltages to be present on devices whose temperature is being measured. Resolution is 0.1° on the 300 mV range of a 3½-digit DMM. Our most accurate DMM temperature probe system.

Temperature Range: -50°C to +150°C or -58°F to +302°F, cable 70°C maximum
Celsius-Fahrenheit Selection: Switch selected
Sensitivity: 1 mV per °C or °F
Resolution: 0.1°C or 0.1°F on the 200 mV range of a 3½ digit dMM
Ambient Temperature Range for Unit: 0°C to +50°C
Relative Humidity: 90%, non-condensing from 0°C to 35°C
Accuracy: (Including nominal 0.25% voltmeter error, in +15°C to +35°C ambient). ±1°C (1.8°F) 0°C to 100°C, decreasing linearly to ±3°C (5.4°F) at -50°C and +150°C

All Accessories have a full 1 year warranty.

Temperature Accessories/Protection and Storage

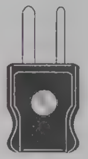
NEW



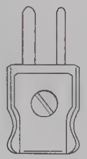
80AK

80AK Thermocouple Adapter Plug

Thermocouple adapter plug adapts Type K thermocouple miniconnector to dual banana plug inputs. Allows use of Fluke thermocouple probe family (80PK-XX) or other Type K probes having miniconnectors with the Fluke model 78 automotive digital multimeter. Compatible only with the Fluke 78.



80CJ-M



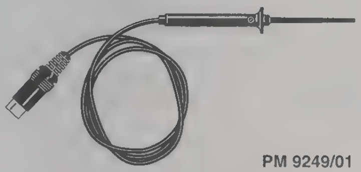
80CK-M

80CJ-M Male Mini Connector

Package of two male black mini-connectors (20 guage max.) for use with Fluke 50 Series. Isothermal screw terminals for attachment of Type-J thermocouple wire.

80CK-M Male Mini Connector

Package of two male mini-connectors for use with Fluke 80TK or Fluke 50 Series. Isothermal screw terminals for attachment of Type-K thermocouple wire.



PM 9249/01

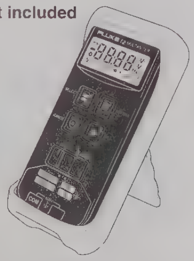
PM 9249/01 Temperature Probe

The PM 9249/01 is a temperature probe for the PM 2518, PM 2618, PM 2718, PM 2525, PM 2528, PM 2534 and PM 2535. The probe contains a PT 100 element and gives the temperature in degrees Celcius with a high accuracy.

Application: Surface and liquids
Temperature Range: -60°C to 200°C
Resolution: 0.1°C
Accuracy (excl DMM): ±0.5% of reading ±0.5°C
Connector: 5-pole DIN (180°)

Holsters

Meter not included



C10

C10 Series 10 Holster

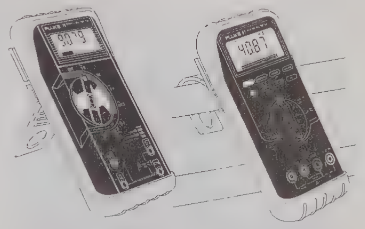
Yellow, snap-on holster for all Series 10 meters absorbs shocks and protects the meter from rough handling. Built-in stand and hanger-loop provide flexibility for positioning meter. Molded hanger-loop can also be used as a stationary probe holder, allowing one hand to hold, operate, and contact test points simultaneously.

ClampMeter not included

C30

C30 Replacement Holster

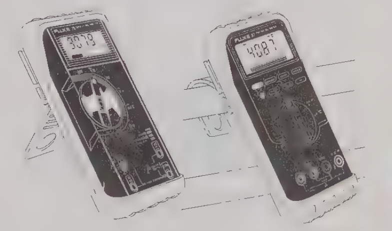
For Fluke 31 and 33 Clamp-Meters. Protects meter display, and has a convenient belt clip for hands free carrying. Rugged velcro closure makes it easy to access meter even when wearing gloves.



Meter not included C70Y

C70Y/C70G Holster

For all Fluke 70 and 50 Series, and 21, 23, 29 meters. Choice of high-visibility yellow (C70Y) or grey (C70G). Easy-to-clean vinyl, snap-on holster absorbs shocks and protects meter from rough handling. Unique Flex-Stand™ has multiple positions and uses, including tilt stand, belt loop, pipe hook etc, for best viewing position of meter. Holster stores test leads and probes. Probes may be snapped into holster so only one hand is needed to hold both the meter and probe tip in contact with test point. **Replaces C70.**



Meter not included C81G/C81Y

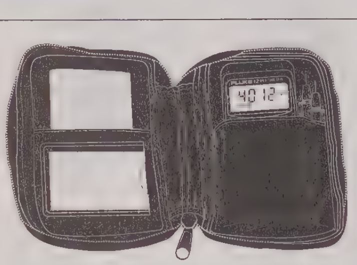
C81G/C81Y Holster

The C81G and C81Y fit Fluke 80 series multimeters. Yellow version (C81Y) is included with multimeter. Grey version (C81G) is optional. Made from durable semiflexible plastic, the C81 holster snaps in place around the multimeter to protect it from rough handling. Unique Flex-Stand™ has multiple positions and uses, including tilt stand, belt loop, pipe hook etc, for best viewing position of meter. Holster stores test leads and probes. Probes may be snapped into holster so only one hand is needed to hold both the meter and probe tip in contact with test point.

All Accessories have a full 1 year warranty.

Protection and Storage

Soft Cases



Meter not included

C12

C12 Series 10 Soft Case

Soft-sided, zippered, vinyl carrying case for all Series 10 meters. Inside pockets are designed to carry a meter, manual, and test leads. Clear pocket fit international business cards. Convenient hanging loop.

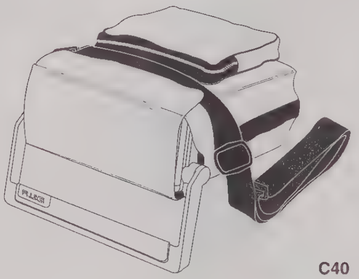
Meter not included

C25

C25 Soft Carrying Case

Thickly padded vinyl with tough exterior and interior and heavy-duty water resistant zipper. Holds DMM and test leads. For Fluke 25, 27, and other Fluke handheld meters including 21, 23, 29, 50 or 70 Series meters in C70 Holster, or 80 Series in C81 Holster. Also for use with the PV350 and PV500. Includes combination belt loop/carrying strap and two inside pockets for test leads or small accessories.

Size: 218.4 mm H x 124.5 mm L x 69.8 mm D (8.3 in H x 4.9 in L x 2.75 in D)



C40

C40 Carrying Case

A soft vinyl plastic case designed for the storage and transport of a 45 DMM or a Hydra Series Data Acquisition unit. A separate storage compartment is provided for test leads and other compact accessories.

Meter not included

C50

C50 Soft Carrying Case

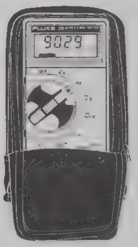
A soft, zippered vinyl case with belt loop for Fluke 21, 23, 29, 50 and 70 Series Multimeters when not in C70G/C70Y Holster. Includes pocket for test leads. Use C25 when using meter with holster.

C75

C75 Test Lead Case

Vinyl carrying case with two inside pockets. Designed to carry test leads, test probes, or clips. Will not accomodate AC83 test clips, high voltage probes, current clamps, or long temperature probes.

Size: 190.5 mm H x 108 mm L x 31.8 mm D (7.25 in H x 4.25 in L x 1.25 in D)



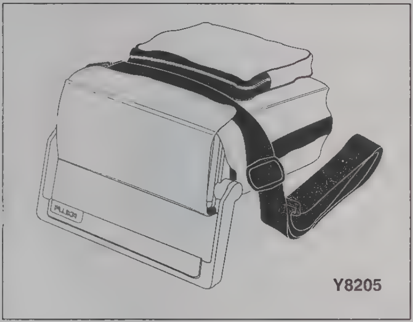
Meter not included

C90

C90 Soft Carrying Case

Constructed of double-wall, fabric-backed vinyl with padded interior and zippered closure for complete protection. Inside pocket holds test leads and operator's instruction card. Carrying strap doubles as belt loop holder. Accomodates Fluke 21, 23, 29, 50 or 70 Series meters in C70 Holster. Not compatible with Fluke 25, 27 or 80 Series meters.

All Accessories have a full 1 year warranty.

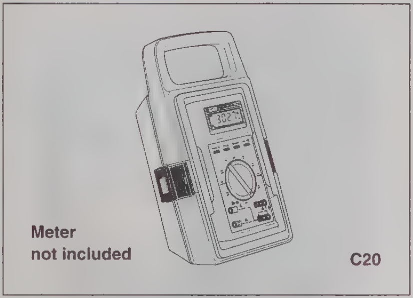


Y8205

Y8205 Soft Carrying Case

A soft vinyl plastic case designed for the storage and transport of either an 8010A, 8012A, 8050A DMM. A separate storage compartment is provided for test leads and other compact accessories.

Hard Cases

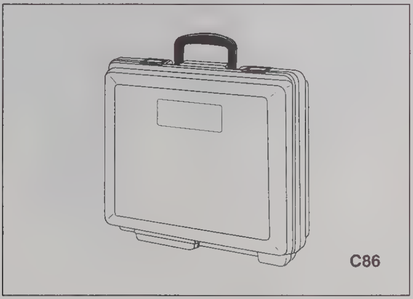


Meter not included

C20

C20 Hard Carrying Case

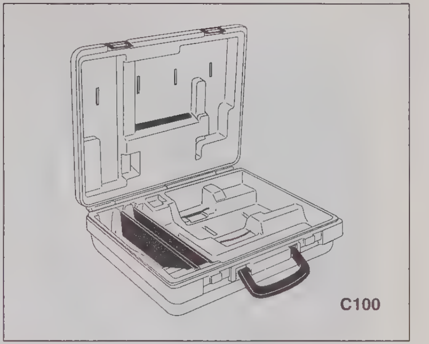
The C20 is a heavy duty hard case made of shock resistant polypropylene. A carrying handle, operator's guide decal, and storage compartment for test leads and other small items is included. The cover is secured by two latches that also latch the case top to the back of the case for convenient storage and to form a tilt-up stand. For Fluke 25/27.



C86

C86 Hard Carrying Case

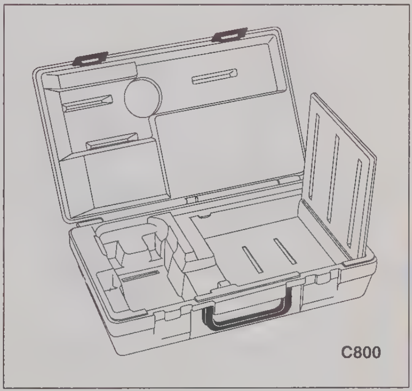
For Fluke 8010A, 8012A, 8000A, 8050A, or 8600A DMMs. This rugged case provides the DMM with maximum protection against rough handling and adverse weather conditions. A separate storage compartment is provided for test leads and other compact accessories.



C100

C100 Hard Carrying Case

A tough, polypropylene case that provides protection against rough handling and bad weather. For any Fluke handheld DMM or Fluke 50 Series thermometers & most Fluke DMM accessories.



C800

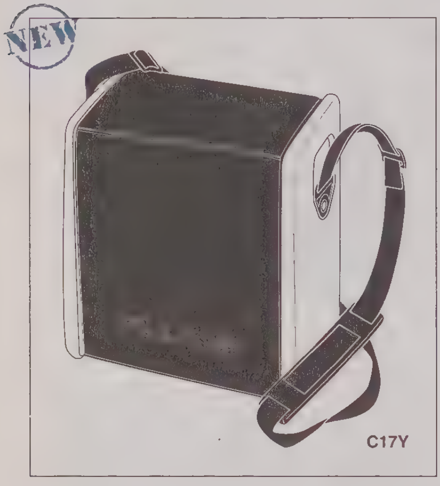
C800 Hard Storage Case

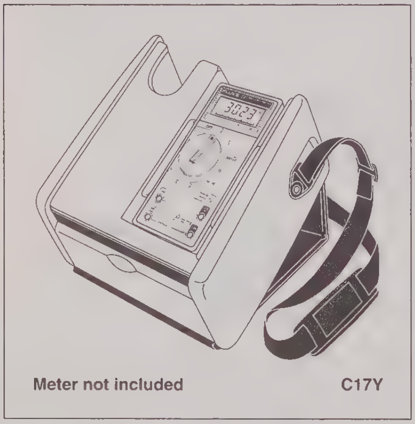
Smaller than C100. Will hold Fluke 70, 21, 23, 29, and 80 Series in holsters. Double-seal latches resist popping open if case is dropped. Lid includes an accessory holding compartment and is detachable for easy storage.

Size: 117.5 mm H x 235 mm D x 368 mm L (4.625 in H x 9.25 in D x 14.5 in L)

All Accessories have a full 1 year warranty.

Protection and Storage

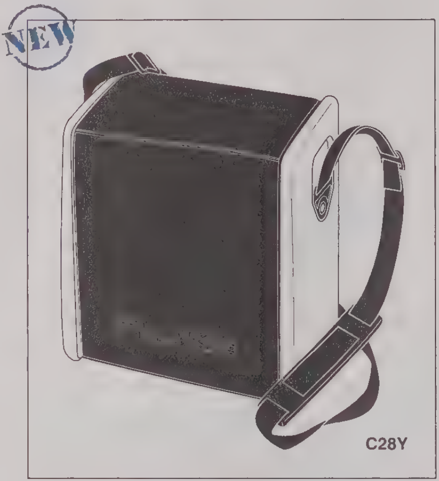


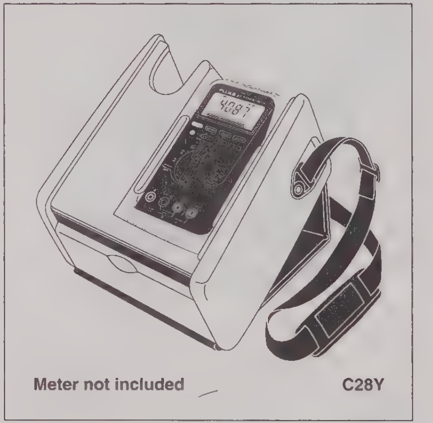


C17Y DuraCase™

A heavy duty hard case with durable vinyl cover that provides protection and storage for meters, current clamps, and accessories. Meter can be used while installed in the case and right angle test leads can remain connected while the case is opened or closed. A Fluke 10 Series (with holster) or any Fluke 70 Series, Fluke 21, 23, 29 digital multimeter, or 51/52 digital thermometer (all without holster) are tightly captured in the case. Durable vinyl cover doubles as tilt stand. Adjustable carrying strap is included. (Meter, current clamp and accessories not included.) Available in high-visibility yellow with grey cover.

Size: 244 mm H x 244 mm L x 140 mm D (9.6 in H x 9.6 in L x 5.5 in D)

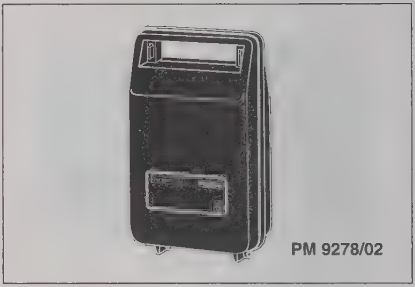




C28Y DuraCase™

A heavy duty hard case with durable vinyl cover that provides protection and storage for meters, current clamps, and accessories. Meter can be used while installed in the case and right angle test leads can remain connected while the case is opened or closed. A Fluke 25/27 or Fluke 80 Series (with holster) digital multimeter is tightly captured in the case. Durable vinyl cover doubles as tilt stand. Adjustable carrying strap is included. (Meter, current clamp and accessories not included.) Available in high-visibility yellow with grey cover.

Size: 244 mm H x 244 mm L x 140 mm D (9.6 in H x 9.6 in L x 5.5 in D)

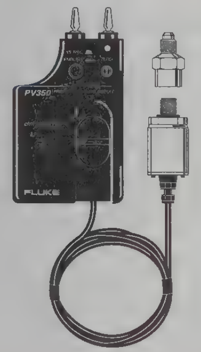


PM 9278/02 Ever-ready Case

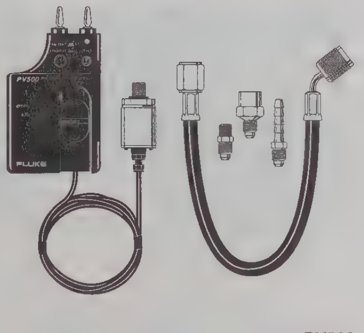
Sturdy shock resistant case with paddings on the inside, for shock absorption and space for accessories (for PM 2518, PM 2618 and PM 2718).

All Accessories have a full 1 year warranty.

NEW



PV350



PV500

PV350/PV500 Digital Pressure/Vacuum Module

- Digital pressure and vacuum measurements in a single module
- Measures HVAC/R, hydraulic and pneumatic pressures to 500 psig
- Measures vacuum to 29.9" Hg
- Compatible with most popular DMMs
- Transducer sealed in 316 stainless steel compatible with variety of liquids and gases
- Works with Fluke 12, 27, 87, 95, or 97 to record Min/Max values
- Displays results in English (psig or Hg) or metric (kPa or cmHg) units

The Fluke PV350/PV500 sets the standard for pressure/vacuum troubleshooting, turning your digital multimeter into a complete measuring system. This compact module plugs into standard diameter banana jacks on the front of any multimeter, to add digital pressure and vacuum measurement to its capabilities.

Pressure and Vacuum in One Handy Package

You can use the PV350/PV500 to measure HVAC/R, hydraulic and pneumatic pressures up to 500/600 psig. Flip the switch and measure vacuum to 29.9 Hg. All with one module. The PV350/PV500 can eliminate the need for a bulky manifold gauge set in many troubleshooting situations.

Rugged, Versatile Performance

You can count on the PV350/PV500 to deliver years of reliable performance with tough use. Its durable heavy-duty case resists moisture, dust and grease, while the rugged, solid state transducer remains accurate much longer than mechanical gauges. Safely sealed in a 316 stainless steel housing, the transducer is protected from impact and the media being measured, so it is ideal for measuring a wide variety of gases and liquids.

Digital Accuracy for Faster Troubleshooting

The PV350 delivers measurements accurate to within 1% of the reading and the PV500 to within 0.8% of the reading. The high resolution digital display on the DMM instantly indicates small changes. Plus the zeroing knob allows you to offset changing barometric pressure.

Easy to Use

A handy front-panel switch lets you change from pressure to vacuum with a flip of the switch. Plus the standard 8-foot cable minimizes the need for a hose and keeps fluid and gas in the system. This prevents potential leaks from hose connections, and allows you to review the results a comfortable distance from the transducer hookup.

Min/Max Recording

If your meter has Min/Max recording capabilities, the PV350/PV500 can record those values in pressure and vacuum as well. This gives you the flexibility to adjust the pressure or vacuum system on the spot and immediately record the effect of those adjustments. The PV350/PV500 requires minimum set up time, so you get to the problem – and the solution – faster.

Multimeter Compatibility

The PV350/PV500 is compatible with any DMM that has a dc millivolt range, standard banana jack input and an input impedance of 10 Megohoms or greater. (For input impedance of 1 Megohm add 0.5% to basic accuracy specification).

High Resolution

Reads 0.1 psig/inch Hg in mV range and 1 psig/inch Hg in Volt range (with $3^1/_2$ - 4 digit multimeter).

PV350 Specifications

Range	Basic Accuracy
Pressure:	
.5 to +350 psig	±1% of reading (±3 psig)
(3.447 to +2413 kPa)	±1% of reading (±2.1 kPa)
350 psig to 500 psig	±5% of reading (1.0 psig) typ
(2413 to 3447 kPa)	±5% of reading (±7.0 kPa)
Vacuum:	
0 to 29.9" Hg	±1% of reading (±3" Hg)
(0 to 76 cm Hg)	±1% of reading (±1.3 cm Hg)

PV500 Specifications

Range	Accuracy
Pressure:	
.5 to +500 psig	±0.8% of reading (0
(3.447 to +3447 kPa)	±0.8% of reading (±2.1 kPA)
500 psig to 600 psig	±5% of reading (±1.0 psig) typ
(3447 to 4137 kPa)	±5% of reading (±7 kPa) typ
Vacuum:	
0 to 29.9" Hg	±1% of reading (±0.5" Hg)
(0 to 76 cm Hg)	±1% of reading (±1.3 cm Hg)

Accuracy specification requires the module be zeroed prior to taking the reading. Accuracy specifications apply over entire specified range and in all units.

Weight: 336g (12 oz)
Battery Life: Typically over 350 hours

Standard Equipment
PV350: The PV350 comes with a 1/4" male pipe thread connector and a 1/4" female pipe thread to 1/4" flare male adapter, 8-foot, 1/4" diameter PVC cable, 9V battery (installed) and manual.
PV500: The PV500 includes a transducer with a 1/4" male pipe thread connector, attached 8-foot connecting cable, 12" neoprene house, a 1/4" male flare to 1/4" female pipe thread adapter, 1/4" male flare to 1/8" male pipe thread adapter, 1/4" male flare to 1/8" hose barb, 9V battery (installed), and manual.

Options/Accessories: A 12" hose is available for the PV350. The C25 soft carrying case is available separately for both the PV350 and PV500.

All Accessories have a full 1 year warranty.

Specialty Accessories

Specialty Accessories

83RF-100 kHz to 100 MHz
85RF-100 kHz to 500 MHz

83RF[2] High Frequency Probe

The 83RF converts a 10 megohm input resistance dc voltmeter into a high frequency, 100 kHz to 100 MHz, ac voltmeter. Ac to dc conversion ratio is on a one-to-one basis over a range of 0.25 to 30V rms. The probe's dc output is calibrated to be equivalent to the rms value of a sinewave input.

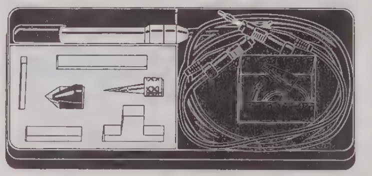
AC-to-DC Ratio: 1:1
Ratio Accuracy: ±1 dB above 1V; ±1.5 dB below 1V (at 1 MHz with 10 MΩ load)
Frequency Response: ±1 dB 100 kHz to 100 MHz (relative to 1 MHz)
Extended Frequency Response: Relative readings from 20 kHz to 250 MHz
Response: Responds to peak value of input; calibrated to read rms value of a sinewave
Voltage Range: 0.25 to 30V rms
Maximum Input Voltage: 30V rms, 200V dc
Input Capacitance: Approximately 3 pF

85RF[2] High Frequency Probe

The 85RF is designed to convert a 10 megohm input resistance dc voltmeter into a high frequency, 100 kHz to 500 MHz, ac voltmeter. Ac to dc conversion ratio is one-to-one over a range of 0.25 to 30V rms. The probes dc output is calibrated to the rms value of a sinewave input.

AC-to-DC Ratio: 1:1
Ratio Accuracy: ±0.5 dB above 0.5V (at 1 MHz with 10 MΩ load) ±1 dB below 0.5V
Frequency Response: ±0.5 dB 100 kHz to 100 MHz; ±1.0 dB 100 MHz to 200 MHz;* ±3.0 dB 200 MHz to 500 MHz* (relative to 1 MHz)
Extended Frequency Response: Relative readings from 20 kHz to 700 MHz
Response: Responds to peak value of input; calibrated to read rms value of a sine wave
Voltage Range: 0.25 to 30V rms
Maximum Input Voltage: 30V rms, 200V dc
Input Capacitance: Approximately 3 pF

**Referred to high and low inputs at probe tip*

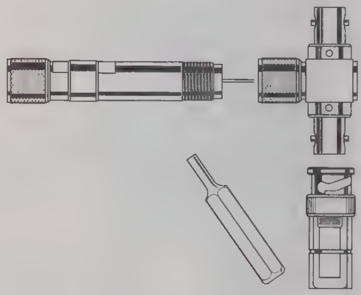


PM 9210

PM 9210 High Frequency Probe

The PM 9210 is designed to convert a 10 MΩ input resistance dc voltmeter into a high frequency, 100 kHz to 1 GHz, ac voltmeter.

AC-to-DC Ratio: 1:1
Ratio Accuracy: ±½ dB at 20°C to 25°C; ±1 dB at 10°C to 30°C
Frequency Response: ±¼ dB at 100 kHz to 1 MHz; ±3 dB 10 kHz to 1 GHz
Response: Responds to peak to peak value of input; calibrated to read rms value of a sine wave.
Voltage Range: 150 mV to 15V
Maximum Input Voltage: 30V rms plus 200V dc
Input Capacitance: Approximately 2 pF
Accessories Supplied: Adjustable earthing pin, dage adapter, earth lead, probe tips, calibration chart.
Accessory Set: PM 9212 (optional)



PM 9212

PM 9212 Accessory Kit

The accessory package contains a 50Ω T-piece, and a 100:1 attenuator for the PM 9210. The combination of the PM 9210 and PM 9212 has the following additional specification.

AC-to-DC Ratio: 100:1
Frequency Response: ±1 dB at 100 kHz to 1 GHz; ±3½ dB 10 KHz to 1 GHz
Voltage Range: 15V to 200V
Maximum Input Voltage: 200V rms + 500V dc
Input Capacitance: Approximately 2 pF
S.W.R.: 1.15 at 1 GHz

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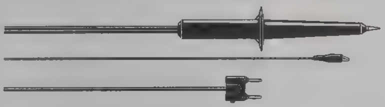
[1] Listed to UL Safety Standards UL1244
[2] Factory Mutual Approved
[3] UL recognized
[4] Heavy Industrial Rating, Overvoltage Category III (CAT III) per IEC 1010-1

All Accessories have a full 1 year warranty.

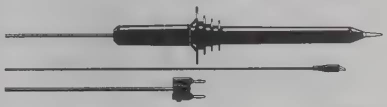


80K-6

80K-6[2,3] High Voltage Probe*

The 80K-6 extends the voltage measuring capability of an ac/dc voltmeter up to 6000 volts. A 1000:1 voltage divider provides a high input impedance. High accuracy is provided when the divider is used with a voltmeter having a 10 MΩ input impedance. A molded plastic body houses the divider and protects user from voltage being measured.

Voltage Range: 0 to 6 kV, dc or peak ac
Input Impedance: 75 MΩ, nominal
Division Ratio: 1000:1
Accuracy: DC to 500 Hz, ±1%; 500 Hz to 1 kHz, ±2%
Above 1 kHz: Output reading falls; typically, -30% at 10 kHz
DVM Compatibility: The 80K-6 achieves rated accuracy when used with an ac/dc voltmeter having 0.25% accuracy, or better, and an input impedance of 10 MΩ ±10%.



80K-40

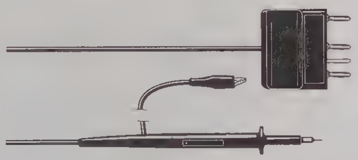
80K-40[2] High Voltage Probe*

The Model 80K-40 is a high voltage accessory probe designed to extend the voltage measuring capability of an ac/dc voltmeter up to 40,000 volts. In essence the probe is a precision 1000:1 voltage divider formed by two matched metal-film resistors. The unusually high input impedance offered by these resistors minimizes circuit loading and optimizes measurement accuracy. A special plastic body houses the divider and provides the user with isolation and protection from the voltage being measured.

Voltage Range: 1 kV to 40 kV dc or peak ac, 28 kV rms ac
Input Resistance: 1000 MΩ
Division Ratio: 1000:1

DC Accuracy
20 kV to 35 kV: ±1% at 20°C to 30°C; add 1% at 10°C to <20°C and >30°C to 45°C (For total measurement accuracy add accuracy specification of voltmeter being used.)
0 kV to <20 kV and >35 kV to 40 kV: ±2%
AC Accuracy: 60 Hz, ±5%
DVM Compatibility: The 80K-40 achieves rated accuracy when used with an ac/dc voltmeter having an input impedance of 10 MΩ ±1%.

***WARNING!**
To avoid damage or electric shock, use high voltage probes under dry conditions (no condensation) in low energy applications, such as CRT supplies.

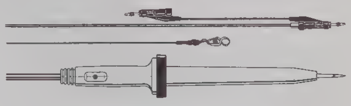


80T-H

80T-H Touch-Hold Probe

The 80T-H is a direct signal-through test probe with a touch and hold feature. Touch-and-hold allows voltage or resistance readings to be held on a digital multimeter display following contact of the probe tip with the test point. Operator can devote full attention to manipulating the probe until the measurement is complete, then remove the probe and observe the reading on the DMM. Activation of a pushbutton on the probe causes the DMM to hold the last number displayed until the pushbutton is released. Works with 8010A, 8012A, 8050A only.

Voltage Rating
Tip to Common: 1000V dc or peak ac maximum
Common to Ground: 60V dc or 42V peak ac maximum
Input Capacitance: 150 pF maximum
Lead Resistance: 0.58Ω maximum

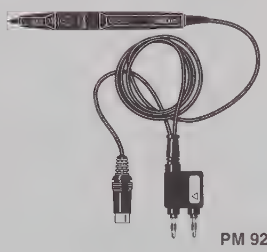


PM 9246/04

PM 9246/04 High Voltage Probe

The PM 9246/04 is a high voltage accessory probe designed to extend the voltage measuring capability of an ac/dc voltmeter up to 30,000 volts. In essence the probe is a precision 1000:1 voltage divider formed by two matched metal-film resistors. The unusually high input impedance offered by these resistors minimizes circuit loading and optimizes measurement accuracy. A special plastic body houses the divider and provides the user with isolation and protection from the voltage being measured.

Caution: These probes are not intended for electric utility applications in which high voltage is also accompanied by high energy. They are also not intended for use on 3 phase line-to-line measurements. Rather, they are intended for use in lower energy applications such as television and CRT troubleshooting.



PM 9267/01

PM 9267/01 Data Hold Probe

The PM 9267/01 is a data hold probe for the PM 2518, PM 2618 and PM 2718 DMMs. It offers the possibility to "freeze" the display if a correct measurement is performed.

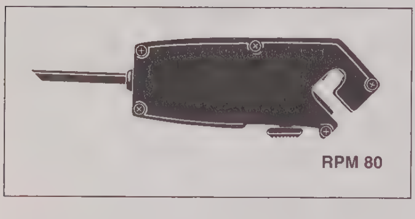
Maximum Input Voltage: 30 kV
Attenuation: x1000
Input Impedance: 600 MΩ ±1%
Accuracy: ±2%
Temperature Coefficient: ±200 ppm/°C
Voltage Coefficient: ±0.5 ppm/V
Input Impedance Meter: 10 MΩ, 100 MΩ or 1.2 MΩ
Output Connectors: 2 x 4 mm banana plug

---

[1] *Listed to UL Safety Standards UL1244*
[2] *Factory Mutual Approved*
[3] *UL recognized*
[4] *Heavy Industrial Rating, Overvoltage Category III (CAT III) per IEC 1010-1*

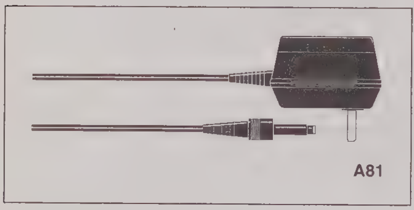
All Accessories have a full 1 year warranty.

Specialty Accessories



RPM 80 Inductive Pickup

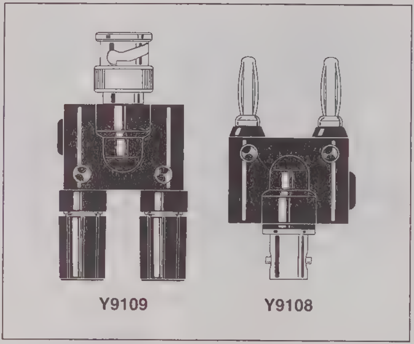
RPM 80 Replacement Inductive Pickup for use only with Fluke 78, 86 and 88 Automotive meters. The Inductive Pickup converts the magnetic field generated by the current in the spark plug wire to a pulse that triggers the Automotive Meter's RPM measurement.



A81 Battery Eliminator

The A81 provides line operation for DMMs without discharging their disposable batteries. Available in three line voltage versions. Specify version desired. See Selection Guide for compatible DMMs.

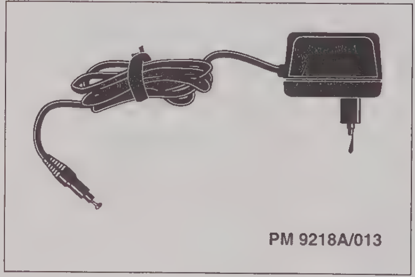
A81-115 115V input (U.S. plug)
A81-230 230V input (European plug)
A81-100 100V input (U.S. plug)



Y9108 & Y9109 BNC-Banana Adapter

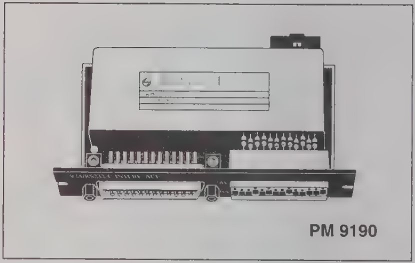
BNC-to-banana adapters permit interconnection between equipment having BNC plugs and equipment with double banana jacks. Caution: Do not use BNC Connectors for floating measurements.

Y9108 BNC Jack to Double Banana Plug
Y9109 Binding Posts to BNC Plug



PM 9218A/013 Power Adapters

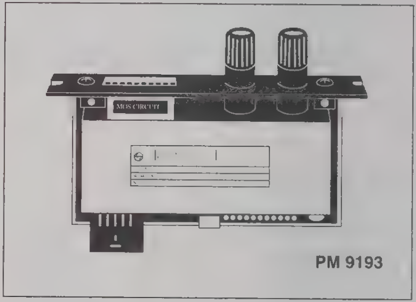
Provides power cord operation for PM 2518.
Line Voltages: 110V ±10%
(Also available in 220V (/011) and 240V (/012) ±10% configurations)



PM 9190/02 RS-232/V-24 Interface

The PM 9190/02 plug-in unit is an RS-232 (or V-24) interface for the PM 2534 and PM 2535.

Connector: 25-pole male D-type
Character Length: 7 or 9 bits
Baud Rate: 110 to 9600 baud
Stop Bits: Communication mode 1 bit; Multidrop mode 2 bits
Parity: Odd, even or none
Handshake: Hardware CTS-DTR protocol; software XON-XOFF
Size: 118 mm W x 25 mm H x 60 mm D (4.6 in W x 1 in H x 2.4 in D)



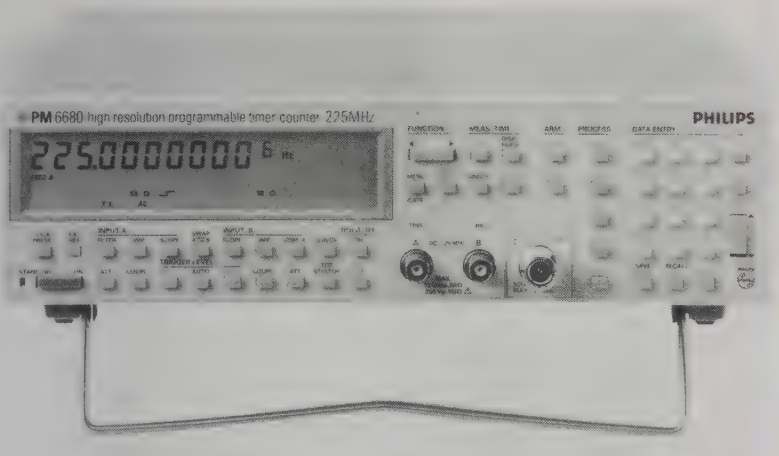
PM 9193/02 Analog Output Option

Can be used with PM 2534 and PM 2535
Power Supply: 5V (±5%)
Connector: 4 mm female banana type
Output Voltage: 0V to 1V
Output Protection: Short-circuit protected
Output Resistance: 200Ω
Accuracy: ±0.25% of reading ±0.25% of range
Size: 118 mm W x 25 mm H x 60 mm D (4.6 in W x 1 in H x 2.4 in D)

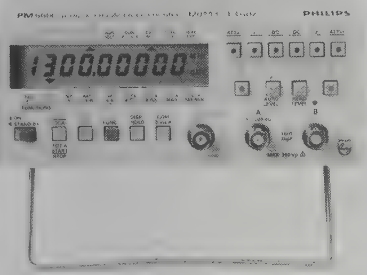
All Accessories have a full 1 year warranty.

For other accessories, see Section 19.

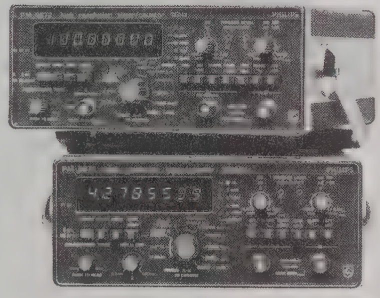
Counters & Timer/Counters


PM 6680 high resolution programmable timer counter 225MHz
PHILIPS
225.0000000

PM 6680 Page 159

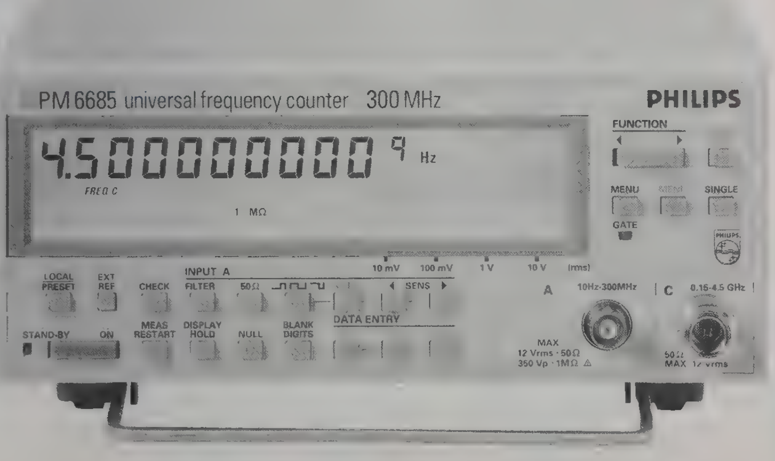

PHILIPS
1300.00000

PM 6666 Page 172


10000000
4.2785599

PM 6671/72 Page 176

NEW


PM 6685 universal frequency counter 300 MHz
PHILIPS
4.500000000 9 Hz
FREQ C
1 MΩ
FUNCTION
MENU
SINGLE
GATE
LOCAL PRESET
EXT REF
CHECK
INPUT A
FILTER
SENS
10 mV
100 mV
1 V
10 V
(rms)
A
10Hz-300MHz
C
0.15-4.5 GHz
STAND-BY
ON
MEAS RESTART
DISPLAY HOLD
NULL
BLANK DIGITS
DATA ENTRY
MAX 12 Vrms · 50Ω 350 Vp · 1MΩ

PM 6685 Page 178

Whether you use frequency counters or timer/counters; on the bench, in the field, or in automated systems, Fluke and Philips can address your time and frequency measurement needs from economical solutions to state-of-the-art performance.

Fluke provides the broadest selection of non-microwave counters in the industry. Models range from the PM 6662, with a price to suit any budget, to the high performance.

PM 6680 which offers single-shot time interval resolution of 350 ps. We also offer the PM 6669, the lowest cost IEEE-488 counter available; the PM 6665, the lowest cost IEEE-488 timer/counter available; and the PM 6666, the lowest cost fully programmable IEEE-488 timer counter available.

The PM 6680 Timer/Counter offers thoroughbred performance at the price of a standard workhorse model. Basic performance includes 350 ps single shot time resolution, a 225 MHz frequency range (up to 4.5 GHz optional) and a measuring speed of up to 2000 readings/second to internal memory. Combined with TimeView software, the PM 6680 becomes a modulation domain analyzer, to characterize frequency behavior or time jitter over time in amazing detail.

The PM 6685 universal frequency counter is the newest addition to Fluke's growing line of frequency counter products. With an input frequency range of 300 MHz (up to 4.5 GHz optional) and a fast 10 digits per second measurement speed, the PM 6685 is designed for demanding portable applications. Options include a rechargeable battery pack and a selection of high stability oven oscillators.

Selection Guide	Page 156
Introduction	Page 157
System Timer/Counters	Page 159
Benchtop Timer/Counters	Page 172
Multifunction Counters	Page 178

Counters & Timer/Counters

Selection Guide

Model	Frequency Range	Max Display Digits	Best Sensitivity (rms)	High Resolution Computing Counting	Frequency Period Ratio Totalizing	Single Shot Time Interval Resolution	Phase	RPM	Pulse Width	Freq Burst	Volt Max/ Min	Page No
System Timer/Counters												
PM 6681*	300 MHz/4.5 GHz	10	20 mV	10-11 digits/s	•	75 ps	•	•	•	•	•	165
PM 6680	225 MHz/4.5 GHz	10	20 mV	10 digits/s	•	350 ps	•	•	•	•	•	159
PM 6666	120 MHz/1.3 GHz	9	20 mV	7 digits/s	•	100 ns					•	172
PM 6652C	120 MHz/2.3 GHz	10	20 mV	7 digits/s	•	100 ns	•	•	•	•	•	169
PM 6654C	120 MHz/2.3 GHz	10	20 mV	9 digits/s	•	2 ns	•	•	•	•	•	169
Benchtop Timer/Counters												
PM 6665	120 MHz/1.3 GHz	9	20 mV	7 digits/s	•	100 ns		•				172
PM 6671	120 MHz	8	10 mV	7 digits/s	•	100 ns	•	•	•	•		176
PM 6672	1 GHz	8	10 mV	7 digits/s	•	100 ns	•	•	•	•		176
Multifunction Counters												
PM 6685	300 MHz/4.5 GHz	10	10 mV	10 digits/s	•				•	•	•	178
PM 6669	120 MHz/1.3 GHz	9	10 mV	7 digits/s	•			•	•			187
PM 6673	120 MHz	9	10 mV	7-8 digits/s	•					•		183
PM 6674	550 MHz	9	10 mV	7-8 digits/s	•					•		183
PM 6675	600 MHz (dir. gated)	9	5/10 mV	7-8 digits/s	•					•		183
PM 6676	1.5 GHz	9	10 mV	7-8 digits/s	•					•		183
PM 6677	2.3 GHz	9	10 mV	7-8 digits/s	•					•		183
Frequency Only Counters												
PM 6662	120 MHz/1.3 GHz	9	15 mV	7 digits/s								187

Model	Rise Time, Duty Factor, MATH	Statistics	Triggering			Options					Page No
			Adjustable Level Selection	Hold-Off	Arming	Best Time Base	Battery	Analog Output	IEEE-488 Control		
									Partial	Full	
System Timer/Counters											
PM 6681	•	•	Auto, Var	•	•	Oven		•		•	165
PM 6680	•	•	Auto, Var	•	•	Oven		•		•	159
PM 6666			Auto, Var			MTCXO	•			•	172
PM 6652C	•		Auto, Var	•	•	Oven		•		•	169
PM 6654C	•		Auto, Var	•	•	Oven		•		•	169
Benchtop Timer/Counters											
PM 6665			Variable			MTCXO	•		•		172
PM 6671			Variable	•	•	Oven	•	•	•		176
PM 6672			Variable		•	Oven	•	•	•		176
Multifunction Counters											
PM 6685	•	•	Auto, Var	•	•	Rubidium	•	•		•	178
PM 6669			Auto, +0-			MTCXO	•		•		187
PM 6673			+0-		•	Oven	•	•	•		183
PM 6674			+0-		•	Oven	•	•	•		183
PM 6675			+0-		•	Oven	•	•	•		183
PM 6676			+0-		•	Oven	•	•	•		183
PM 6677			+0-		•	Oven	•	•	•		183
Frequency Only Counters											
PM 6662			Auto			MTCXO	•				187

1953A, 7260A, 7261A recommended replacement: PM 6680
7250A recommended replacement: PM 6666
PM 6670 recommended replacement: PM 6665

1900A recommended replacement: PM 6662 or PM 6669
1910A, 1911A, 1912A recommended replacement: PM 6669

** Preliminary data available fall 1993. Call for latest details.*

Applications for frequency and time-related measurements vary considerably. Requirements can include high-accuracy frequency calibration of RF signals, frequency measurements on noisy signals, accurate propagation delay measurements, phase shift in filters, high resolution counting on low frequency tone control signals, etc.

The instruments which perform these time-related measurements are generally known as counters. There are quite a number of names for various classes of these products which date back to the era before microprocessors were incorporated into counters. Today, there are two categories of these instruments: frequency counters and timer/counters.

Frequency Counters

A frequency counter has a single input channel, and sometimes an additional prescaled input for measuring high frequencies. The most basic units offer frequency-only measurements. Most counters offer the following functions:

- Frequency
- Period

More versatile instruments also offer:

- Totalizing (Pulse Counting)
- Frequency ratio (relative mode)
- Frequency deviation (relative mode)
- Pulse Width
- RPM (freq x 60)

Typical applications for these products range from high accuracy calibrations of telecommunications equipment (normally in the RF range) down to low-cost frequency indicators for small repair workshops and hobbyists.

Timer/Counters

In addition to the frequency measurements noted above, a timer/counter can also perform time interval measurement between two events (start and stop event). A timer/counter is therefore characterized by its dual and identical input channels, the start and stop channels (usually labeled A and B). A third input channel can be added for prescaled HF frequency measurements. Almost all timer/counters offer the following functions:

- Frequency
- Period
- Time Interval (Channel A to Channel B)
- Frequency Ratio (Channel A/Channel B)
- Totalizing

More advanced models offer a wealth of different functions, with the most common listed below:

- Pulse Width
- Rise/Fall Time
- Voltage Measurements
- Phase Delay (A to B)
- Duty Factor

Fluke Electronic Counters

Frequency Counters		Timer/Counters	
Frequency Only Counters	Multifunction Frequency Counters	Bench-Top Timer/Counters	System Timer/Counters
PM 6662	PM 6669 PM 6673 PM 6674 PM 6675 PM 6676 PM 6677 PM 6685	PM 6665 PM 6671 PM 6672	PM 6652C PM 6654C PM 6666 PM 6680

Timer/counters are found in the lab or on the service bench and also in systems. These systems vary from small temporary set-ups to large ATE systems. Consequently, there is a choice between bench top and systems models. Bench top units can be equipped with a GPIB/IEEE-488* interface, allowing programming of most major functions. Systems units allow programming of all input settings, including trigger level and attenuation.

Optional Accessories

The conditions of use are important. Use in the field, on a laboratory bench or in an automatic test system require different options such as: battery supply, analog output (for recording on a strip-chart recorder), IEEE-488 bus interface, rack mount facilities, ultra-high stability oven oscillators, etc.

In selecting a counter, the availability of a wide range of such options is of great importance especially when the type of application may change after some time in use.

Front-end Circuitry Requirements

The requirements for input signal-conditioning when making frequency and time measurements are somewhat contradictory as the following observations will illustrate.

Frequency Counting

Figure 1a shows a sinewave signal crossing the hysteresis band of the input circuit. Each period of the sinewave that crosses the hysteresis band should cause a clean pulse that can be counted by the digital circuitry.

Noise on the sinewave, however, causes the signal to pass through the hysteresis band more than once per sinewave period giving false counts. Figure 1b shows how an expanded hysteresis band can prevent this type of error.

Time Interval Measurement

Figure 2a shows a pulse, the duration of which is to be measured. Triggering at 50% of amplitude should start the time measurement at A and stop it at B.

The hysteresis of the input circuit, however, causes triggering to occur at A1 and B1. The different slopes of leading and trailing edges cause different delays, resulting in a faulty measurement. A very narrow hysteresis band as shown in Figure 2b will reduce these errors.

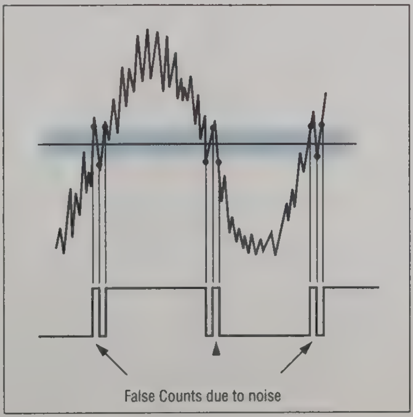


Figure 1a.

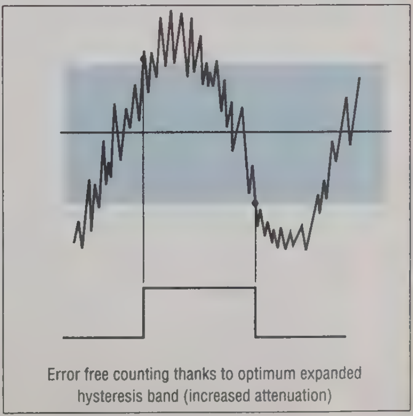

Error free counting thanks to optimum expanded hysteresis band (increased attenuation)

Figure 1b.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Introduction

Error-Free Triggering

Figure 1b shows that "error-free" frequency counting is obtained by a wider hysteresis band or, in other words, by an attenuated input signal.

Thus for frequency measurement a continuously variable input attenuator permits optimum matching of the input signal to the counter's trigger sensitivity.

Figure 2b shows that a lower hysteresis voltage will minimize the time measurement error.

Thus a low hysteresis voltage (narrow trigger window) together with a continuously variable trigger level setting permits accurate time interval measurements.

AC-Coupling

Frequency counting on sinewaves or on generally symmetrical signals is best achieved with ac-coupled inputs. AC-coupling has no temperature drift problems, while added dc signal components are eliminated. This assures simple, stable, and thus, reliable triggering.

Frequency counters also need to measure on narrow pulses or other waveforms.

Triggering on any waveform, having any duty factor can be performed by means of a trigger level off-set in the input channel amplifier, see Figure 3.

DC-Coupling

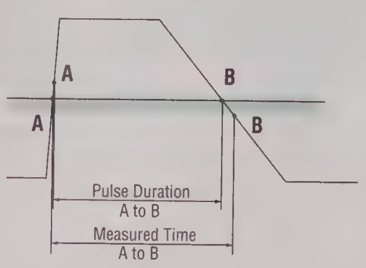
Time interval measurements with accurately set trigger levels, or those that are waveform-independent, require dc-coupling. This might include rise time measurement on a pulse, requiring 10% to 90% level setting, or a pulse duration measurement with accurate setting of trigger levels at 50% of the pulse amplitude.

Crystal Oscillators

A counter's maximum accuracy is ultimately limited by its time base reference accuracy.

Depending on the application requirement, most counter models can be ordered with a choice of different crystal oscillator time base options.

The oscillator with the highest available stability (PM 9691), features a stability of 5×10^{-10}/24h, and can be included in the high accuracy counters of the PM 667X Series, PM 6680 and PM 6685.



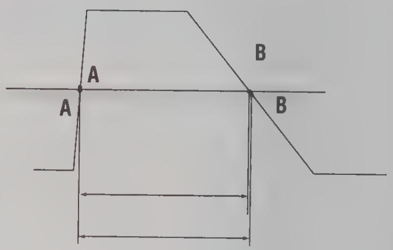
Measured time is too long. The hysteresis causes different delay due to different slopes

Figure 2a.

Selection of Time Base Option

Depending on the application accuracy requirement, operating temperature range and tolerated recalibration interval, a suitable time base selection can be made. As general indication, one can state that the accuracy limitation, caused by the time base is as follows:

No. of Digits	Type of Crystal Oscillator	Option Numbers
5-6	Standard or Uncompensated	Standard or /.1.
6-7	TCXO w/analog Compensation	TCXO, /.2. or PM 9678
7-8	TCXO w/Mathematic Compensation (MTCXO) or Oven Control	MTCXO or /.3., /.4. or PM 9607, PM 9679, PM 9690
8-9	Ultra High Stability Oven Control	/.5. or PM 9691



Greatly reduced trigger error due to very narrow hysteresis band

Figure 2b.

Time Base Inaccuracy (Relative Error):

Time base error is determined by the summary of the following terms:

$$\frac{\partial f}{F} = \pm \frac{\partial fa}{F} \pm \frac{\partial ft}{F} \pm \frac{\partial fs}{F}; \quad \text{where}$$

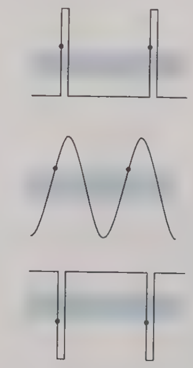
∂f : the deviation from the nominal 10 MHz crystal frequency

F : nominal 10 MHz crystal frequency

$\frac{\partial fa}{F}$: relative deviation due to aging

$\frac{\partial ft}{F}$: relative deviation due to temperature changes from calibration temperature

$\frac{\partial fs}{F}$: relative deviation due to supply voltage and/or supply mode variation



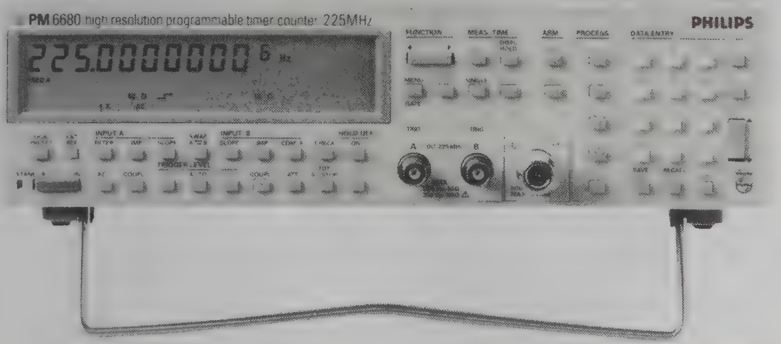
Push ⎍⎍ button for triggering on signal with duty factors of 0 to 0.25

Push ⎍ button for duty factors between 0.25 to 0.75

Push ⎍⎍ button for duty factors of 0.75 to 1

Figure 3.

PM 6680



PM 6680

PM 6680 High Resolution Programmable Timer/Counter

- 350 ps single-shot time resolution, typically 250 ps
- 225 MHz input (1.3 GHz, 2.7 GHz or 4.5 GHz optional)
- 2,000 readings/s to internal memory
- Store/recall 20 instrument settings
- Unique triggering control to measure any complex signal
- Analysis of jitter, modulation and frequency transients
- Analysis with built-in statistical functions
- Optional time and frequency analysis software (TimeView)

Measuring Power

For the price, PM 6680 features a remarkably high 350 picosecond resolution for single-shot time intervals. For more resolution, repetitive time intervals can also be averaged. You also have resolution of 10 digits a second for frequency measurements, independent of input frequency.

You get a frequency input range of dc to 225 MHz, with options of 1.3, 2.7 GHz or 4.5 GHz.

High System Performance

For systems users, the PM 6680 offers a high measurement rate to internal memory of up to 2,000 readings/s.

Naturally, the PM 6680 complies with the latest GPIB/IEEE-488.2* bus standard and the internationally standardized SCPI command set (Standard Commands for Programmable Instruments). Which makes writing instrument code and supporting it much easier.

Whether you work on the bench or in an ATE environment, you can capture and process measurement data quickly. How does on-board statistical processing of 1,000 measurements in about three seconds sound?

So what does all this high measuring speed, high single-shot resolution and triggering power mean? You now have a cost-efficient way to analyze new types of measurements such as time jitter, modulation and frequency transients.

We Make the Most of Any Complicated Signal

Thanks to our extensive arming and hold-off modes, you have complete control over your start/stop trigger conditioning.

All of which lets you capture and measure the frequency and time characteristics of virtually any signal. No matter how complex it is.

Also, you have a wide choice of measuring functions at your disposal, from phase and duty factor to rise/fall time and Vpeak, plus six different totalizing modes including simultaneous up/down event counting during a preset time.

Built-in Statistics For Faster Analysis

While we call the PM 6680 a timer/counter, we added more to make it worthy of your bench. Now and in the future.

That's why we offer a variety of analysis tools for time and frequency measurements. Specialized tools that are usually found on dedicated (i.e. more costly) instruments.

Again using the superb measuring speed and built-in memory you can, for example, read jitter calculated from thousands of input cycles – in just a few seconds.

You also have stand-alone processing power thanks to the built-in mathematics and statistics functions. You'll find everything from inversion, normalization, scaling, offset and drift to mean value, standard deviation, and maximum and minimum values.

Built For Demanding Use

The PM 6680 comes with a choice of four different internal time-base oscillators for setting the accuracy limits of any measurement.

Choose from a standard crystal oscillator, a TCXO, or two ovenized time-base oscillators, with stability performance up to 5 x 10^{-10} (24 hours).

As with every instrument we make, the PM 6680 family is built to be used and used and used. To this end, we designed a highly integrated system comprising just two VLSI-ASICs, plus a fast 16-bit microcontroller for the entire digital circuitry. All of which reduces power consumption while offering an MTBF of over 30,000 hours.

As further testimony to quality and durability, every timer/counter employs modern surface-mount technology and rugged all metal construction to withstand mechanical shocks and protect against electromagnetic interference.

More Versatile Measuring Functions

We took a basic counter function – event totalization – and extended it to include such advances as simultaneous up-counts and down-counts; totalization during a preset time; and cumulative totalization of input A events, gated by B.

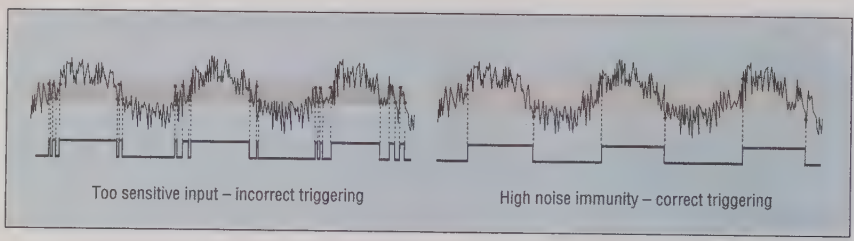
With the built-in phase measurement tool, the PM 6680 acts like three instruments in one, measuring frequency, amplitude and phase.

Which is important for things such as filter and amplifier characterization.

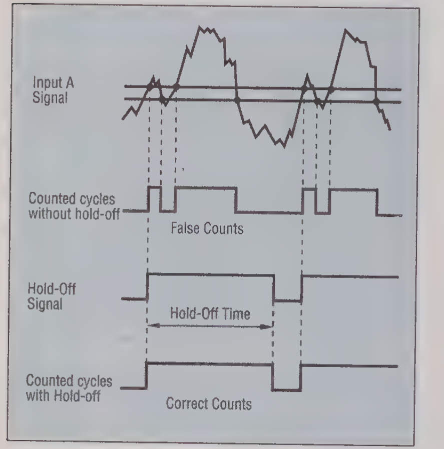
Our timer/counter also offers Vmax and Vmin measurements, whether on LF-sine waves or high-speed pulses. When you combine this with time measurements (period, pulse width, etc.), pulses can be fully characterized in your test system – without the need for additional equipment.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

PM 6680


Too sensitive input – incorrect triggering
High noise immunity – correct triggering

The variable hysteresis mode enables wide band 60 mV to 10V p-p noise suppression.



The trigger hold-off can be used to remove the influence of spurious signals

Correct Triggering

Every counter can trigger correctly on undistorted sine waves and square waves. It's the erratic signals that throw them for a loop.

The PM 6680 can trigger on them all, including noisy/distorted, asymmetrical and AM-modulated signals as well as burst signals and those with drifting dc components.

What's more, our AUTO-trigger ensures correct, foolproof triggering for any repetitive signal over 100 Hz. It automatically positions the trigger level at 50% amplitude, regardless of duty factor and dc offsets. In rise/fall time measurements, your levels are set at 10% and 90%.

Noise Immunity

We've also clamped down on noise with features designed to increased noise immunity to prevent noise or interference from causing false triggering.

You have a 100 kHz analog low-pass filter for suppressing high frequency noise and spurious interference that is stronger than the input signal itself.

Our trigger hold-off eliminates, in time measurements, such distortions as bounces and ringing. As for frequency and ratio measurements, the hold-off serves as a digital low-pass filter up to 5 MHz.

Finally, the PM 6680 offers a unique variable hysteresis mode for noise immunity in frequency measurements. This allows the trigger hysteresis to be set manually or automatically, to any value between 60 mV to 10V p-p, thereby suppressing spurious signals, no matter what their frequency.

Everything Is Easy To Get To

While the PM 6680 is a powerful, timer/counter, the flip side is that it's easy to use and program.

Inside are numerous built-in functions for on-board processing, as well as functions that quickly automate or simplify operations.

Take the mathematics functions. You don't need a controller to perform a variety of tasks, such as inversion, offset, scaling and normalizing.

The PM 6680 makes it easy to follow measurement drift in any measurement function by displaying X_n-X_{n-1}. It also simplifies testing of heterodyne receivers. The tuned frequency can be expressed as the local oscillator frequency, offset by the IF-value.

With our statistics function (which don't require a controller either), you have valuable tools for stability and jitter analysis. Such as with pulse analysis, where the measured standard deviation of a time-interval represents the rms-jitter.

These functions can be applied to any measurements, displaying such things as mean value, standard deviation, and maximum and minimum values.

Another feature that helps you get your measurement fast is our unique probe compensation outputs, which helps you to make accurate time measurements when measuring probes are needed.

You can also save and recall up to 20 complete front panel settings in a non-volatile memory for instant access to frequently used test set-ups. Plus, when you shut off the power, the current front panel setting is automatically stored.

Other features include a bus-learn mode that transfers manually-set functions to the controller and macro-programming for fast access to complex measurement set-ups.

Our Standards Are What Others Call Extras

Take for instance, our IEEE-488 interface which also includes an analog recorder output. It provides a dc-voltage proportional to the value of any three consecutive digits displayed. So it can be used for strip-chart recording or feedback to an analog control regulating system.

With your gated voltage measurements, the PM 6680 can mask, with an external gate signal, portions of the input signal containing things such as overshoot.

Arm Yourself With Better Analysis Tools

If your measurements involve characterization of time or frequency variations versus time, the PM 6680 is an ideal choice.

Thanks to our high sampling speed and small measurement aperture, individual measurements can be made at 500 microsecond intervals with full resolution.

What's more, you have plenty of options at your disposal with our arming tools. For instance, start and stop arming uses an external qualifier signal to pinpoint your measurement's beginning or end, and can be used as an external gate signal. And time delay arming can be used, for instance, for sequential sampling of repetitive signals. So you can perform, for example, dynamic frequency characterization by just programming the time delay before the input is armed. High-speed repetitive transients can also be characterized, since time delays can be incremented in steps as low as 100 nanoseconds.

Or, instead of arming delay by a preset time, delay with a number of trigger events. Which allows you to characterize such things as serial data, and to measure pulse parameters – such as pulse period, width, and rise/fall times – on selected pulses in a pulse stream.

The time between any two trigger events can even be measured, no matter how complex the signal. Just combine arming with a delay or trigger hold-off to capture otherwise elusive data.

Get Into All Kinds of Analysis, Fast with the PM 9629 TimeView™ Analysis Software

As we've said, the PM 6680 was designed for top performance. And your money also buys you a tool for analysis of frequency transients, drift, FM modulation, etc.

With its high sampling speed and single-shot resolution, you can make a block of measurements and store them in internal memory, all at high speed. Post processing can be done afterwards when transferred to a controller.

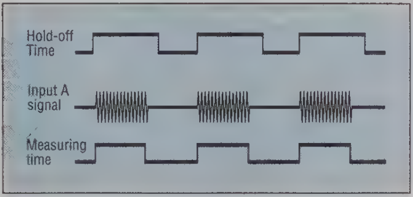
And our unique PC-based analysis software TimeView (PM 9629) can together with the PM 6680 perform high-accuracy frequency measurements of signals that vary with time, such as swept and hopping frequencies, VCO output signals, and pulsed radio frequencies or other burst signals. TimeView also allows you to plot a complete profile of frequency variations for even deeper analysis. (See page 166)

PM 6680

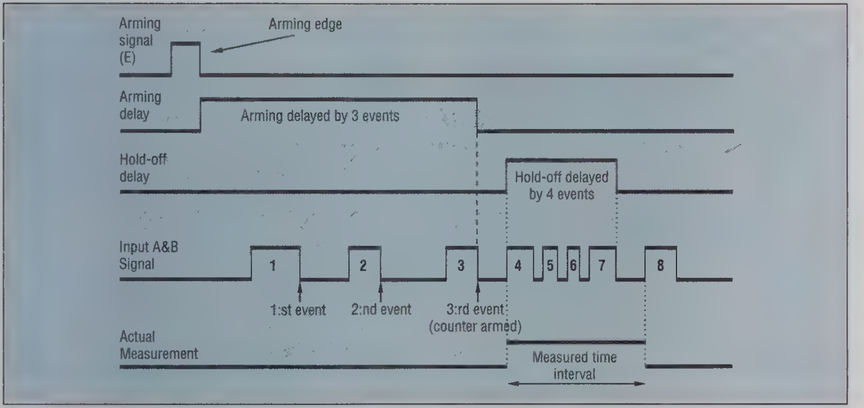
We Help Correct The Jitters

The high measuring speed of the PM 6680 along with its built-in statistics make time jitter analysis easy and trouble-free.

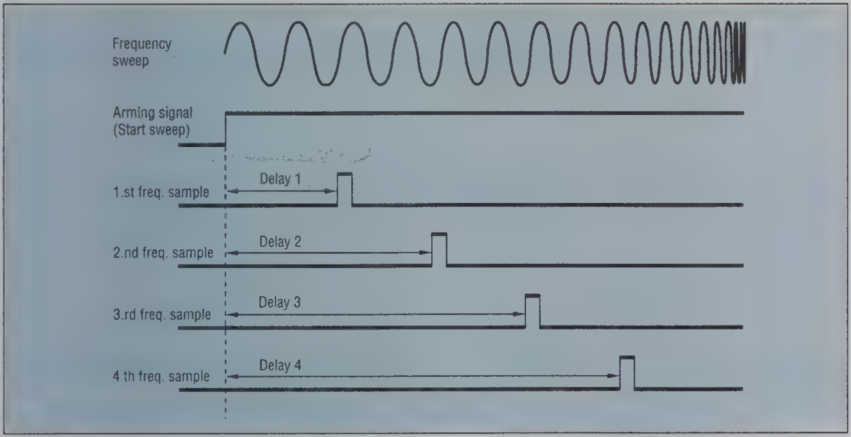
For one thing, rms-jitter is read directly as standard deviations of time interval measurements, with peak deviations also readily available. So it takes just three seconds to capture and process typical rms-jitter over a thousand measurements. With a controller, you can even capture the same data in about 500 milliseconds.


Hold-off Time
Input A signal
Measuring time

PRF and burst frequency measurements can easily be made without external gating signals.


Arming signal (E)
Arming edge
Arming delay
Arming delayed by 3 events
Hold-off delay
Hold-off delayed by 4 events
Input A&B Signal
1
2
3
4
5
6
7
8
1:st event
2:nd event
3:rd event (counter armed)
Actual Measurement
Measured time interval

Example: Time between pulse no. 4 and no. 8 using Arming and Hold-off with event count delay.


Frequency sweep
Arming signal (Start sweep)
1.st freq. sample
Delay 1
2.nd freq. sample
Delay 2
3.rd freq. sample
Delay 3
4 th freq. sample
Delay 4

Example: High-accuracy frequency measurement of a signal that varies with time.

Specifications

Measuring Functions

Refer to table 1 for uncertainty information. Inputs A and B can be swapped internally in all modes except Rise and Fall Time (for example to measure Frequency B).

Frequency A, B, C

Range
Input A: 10^{-10} Hz to 225 MHz
Input B: 10^{-10} Hz to 160 MHz
Input C: 70 MHz to 1.3 GHz w/optional PM 9621
100 MHz to 2.7 GHz w/optional PM 9624
150 MHz to 4.5 GHz w/optional PM 9625
Resolution: 10 digits in 1s measuring time

Frequency Burst A: Frequency and PRF of burst signals to 160 MHz can be measured without external control signal

Period A

Range: 6 ns to 10^{10}s
Resolution: 10 digits in 1s measuring time

Ratio A/B, C/B

Range: 10^{-9} to 10^{15}

Frequency Range
Input A, B: 10^{-10} Hz to 160 MHz
Input C: 70 MHz to 1.3 GHz w/optional PM 9621
100 MHz to 2.7 GHz w/optional PM 9624
150 MHz to 4.5 GHz w/optional PM 9625

Time Interval A to B

Range: 0 ns to 10^{10}s, -2 ns to 10^{10}s typical
Repetition Rate: Maximum 160 MHz
Mode: Single of average

Pulse Width A

Range: 3 ns to 10^{10}s
Repetition Rate: Maximum 160 MHz
Mode: Single or average

Rise and Fall Time A

Range: 3 ns to 10^{10}s
Repetition Rate: Maximum 160 MHz
Minimum Amplitude: 500 mV p-p
Mode: Single or average

Phase A Relative B

Range: -180° to +360°
Frequency Range: 0.01 Hz to 160 MHz

Voltage Range
x1: 100 mV rms to 3.5V rms
x10: 1V rms to 35V rms
Mode: Single or average

Duty Factor A

Range: 0 to 1
Frequency Range: 0.01 Hz to 160 MHz
Mode: Single or average

Totalize A, B

Range: 0 to 10^{17} 0 to 10^{10} in Manual A-B modes
Frequency Range: 0 to 160 MHz
A Gated by B: Event counting on Input A during the presence of a pulse on Input B
A Gated by B Accumulated: Cumulative event counting on Input A during the presence of pulses on Input B, within set measuring time
A Start/Stop by B: Event counting on Input A between two consecutive pulses on Input B
Manual A: Event counting on Input A with manual start and stop
Manual A-B: Input A minus Input B event counting with manual start and stop
Manual/Timed A: Event counting on Input A with manual start. Stop after set measuring time
Manual/Timed A-B: Input A minus Input B event counting with manual start. Stop after set measuring time

PM 6680

AC/DC Voltage A, B

Range: -51V to +51V
Frequency Range: DC, 100 Hz to 120 MHz
Mode: V max, V min, V p-p

Uncertainty for DC: >10 ns Pulses and Sine waves
<50 MHz (x 1): ± (30 mV + 2% of reading + 5% of V p-p)
<50 MHz (x10): ± (300 mV + 3% of reading + 5% of V p-p)
>50 MHz (x 1): ± (30 mV + 3% of reading + 10% of V p-p)
>50 MHz (x10): ± (300 mV + 5% of reading + 10% of V p-p)

Gated Volt: External masking of unwanted signal components such as overshoot

Input Specifications

Input A and Input B

Frequency Range Input A
DC-Coupled: DC to 225 MHz
AC-Coupled: 10 Hz to 225 MHz

Frequency Range Input B
DC-Coupled: DC to 160 MHz
AC-Coupled: 10 Hz to 160 MHz

Rise Time: Approx 1.5 ns
Coupling: AC or dc
Impedance:1MΩ//30 pF or 50Ω (VSWR ≤ 2:1) 1 MΩ//80 pF or 50Ω (PM 9611/80 rear panel inputs)
Trigger Slope: Positive or negative
Channel Inputs: Separate, common A or swapped
Sensitivity: 20 mV rms, <100 MHz; 30 mV rms, 100 MHz to 200 MHz; 40 mV rms, > 200 MHz
Minimum Pulse Width: 5 ns at 60 mV p-p, 3 ns at 90 mV p-p
Attenuation: x 1 or x10
Hysteresis Window: Approx 30 mV p-p
Variable Hysteresis A: 60 mV p-p to 10V p-p up to 120 MHz

Dynamic Range
x 1: 60 mV p-p to 10V p-p within ±5V window
x10: 0.6V p-p to 100V p-p within ±50V window

Trigger Level Range
x 1: -5.10V to +5.10V
x10: -51.0V to +51.0V
Trigger Level Read-Out: On display

Trigger Level Resolution
x 1: 20 mV
x10: 200 mV

Trigger Level Setting Uncertainty (x1)
Separate Inputs: ± (20 mV + 1% of setting)
Common Input: ± (20 mV + 3% of setting)

AUTO Trigger Level
Minimum Amplitude: 150 mV p-p
Minimum Frequency: 100 Hz

Trigger level is automatically set to 50% point of input signal (10% and 90% for Rise and Fall Time measurements)

Analog Lowpass Filter Channel A:100 kHz fixed, > 40 dB attenuation at 1 MHz

Digital Lowpass Filter Channel A and B:1 Hz to 5 MHz using trigger Hold-Off to disable stop triggering

Trigger Indicator: Tri-state LED-indicator

Maximum Voltage Without Damage
1 MΩ: 350V (dc + ac pk) at dc to 440 Hz, falling to 12V rms (x1) and 120V rms (x10) at MHz
50Ω: 12V rms

Input C (Option PM 9621)

Frequency Range: 70 MHz to 1.3 GHz
Prescaler Factor: 256
Coupling: AC
Operating Input Voltage Range: 10 mV rms to 12V rms, 70 MHz to 900 MHz; 15 mV rms to 12V rms, 900 MHz to 1.1 GHz; 40 mV rms to 12V rms, 1,1 GHz to 1.3 GHz

Amplitude Modulation
AM Freq. DC to 100 kHz: Up to 94% depth
AM Freq. 100 kHz to 6 MHz: Up to 85% depth
Minimum signal must exceed minimum operating input voltage.

Impedance: 50Ω nominal, VSWR < 2:1
Maximum Voltage Without Damage: 12V rms, pin-diode protected
Connector: BNC

Input C (Option PM 9624)

Frequency Range: 100 MHz to 2.7 GHz
Prescaler Factor: 16
Coupling: AC
Operating Input Voltage Range: 20 mV rms to 12V rms, 100 MHz to 300 MHz; 10 mV rms to 12V rms, 300 MHz to 2.5 GHz; 20 mV rms to 12V rms, 2.5 GHz to 2.7 GHz

Amplitude Modulation
AM Freq. DC to 100 kHz: Up to 94% depth
AM Freq. 100 kHz to 6 MHz: Up to 85% depth
Minimum signal must exceed minimum operating input voltage

Impedance: 50Ω nominal
VSWR <2:1, 150 MHz to 3.5 GHz
VSWR <2.5:1, 3.5 GHz to 4 GHz
VSWR < 2.5:1, 1.8 GHz to 2.7 GHz
Maximum Voltage Without Damage: 12V rms, pins-diode protected
Connector: Type N Female

Input C (Option PM 9625)

Frequency Range: 150 MHz to 4.5 GHz
Prescaler Factor: 32
Coupling: AC
Operating Input Voltage Range: 20 mV rms to 12V rms, 150 MHz to 300 MHz; 10 mV rms to 12V rms, 300 MHz to 2.7 GHz; 15 mV rms to 12V rms, 2.7 GHz to 3.5 GHz; 25 mV rms to 12V rms, 3.5 GHz to 4.5 GHz

Amplitude Modulation
AM Freq. DC to 100 kHz: Up to 94% depth
AM Freq. 100 kHz to 6 MHz: Up to 85% depth
Minimum signal must exceed minimum operating input voltage

Impedance: 50Ω nominal,
VSWR <2:1, 150 MHz to 3.5 GHz
VSWR <2.5:1, 3.5 GHz to 4 GHz
VSWR <3:1, 4 GHz to 4.5 GHz

Maximum Voltage Without Damage: 12V rms, pin-diode protected
Connector: Type N Female

External Reference Input D

The use of external reference is indicated on the display
Frequency: 10 MHz standard, 1 MHz and 5 MHz with Optional Reference Frequency Multiplier (PM 9697)
Voltage Range: 500 mV rms to 10V rms
Coupling: AC
Impedance: >1 kΩ for signals <1V rms, approx 500Ω for signals ≤1V rms

Arming Input E

Most measuring functions can also be performed via Input E
Frequency Range: DC to 50 MHz
Minimum Pulse Width: 10 ns
Minimum Slew Rate: 2V/µs
Trigger Level: TTL level, 1.4V nominal
Trigger Slope: Positive or negative
Damage Level: 25V
Coupling: DC
Impedance: >1 kΩ for signals <1V rms, approx 500Ω for signals >1V rms

Output Specifications

Reference Output G

Frequency: 10 MHz, sine wave
Output Level: >0.5V rms into 50Ω load; >0.7V rms into high impedance load
Coupling: AC

Gate Open Output H

Output Level
Gate Closed: <0.4V
Gate Open: >1.4V into 50Ω load, >2.8V into high impedance load
Internal delay: Approx 20 ns

Trigger Level Outputs I, J

Buffered outputs for channel A and B trigger levels

Output Level
x 1: 0.1 x Trigger Level Setting
x 10: 0.01 x Trigger Level Setting

Uncertainty: ±(3 mV + 8% of output level)
Output Impedance: Approx 3 kΩ

PM 6680

Probe Compensation Outputs K,L

Buffered outputs for channel A and B signals. To be used for adjustment of probes to best pulse response for the combination of probe and counter input
Output Level: (Input level)/(Attenuator setting)
Test Signal: 2 kHz to 3 kHz square wave
Output Impedance: Approx 1.5 kΩ

Auxiliary Functions

Trigger Hold-Off

After start of measurement, Trigger Hold-Off disables erroneous stop triggering during a preset time. The Hold-Off can also be defined as a preset number of trigger events on channel B. Trigger Hold-Off can be used in all measuring functions, except Duty Factor and AC/DC Voltage.
Time Delay Range: 200 ns to 1.6s
Resolution: 100 ns
Channel B Event Delay Range: 2 to 2^{24}-1, negative slope (maximum 20 MHz)

External Arming

Arming is used to inhibit start- and/or stop triggering with the aid of an external signal.
Input: E or B. Trigger level on B channel can be set to position the arming trigger event
Arming Delay: Arming can be delayed with respect to the external arming trigger event until:
- Preset arming time has elapsed or
- Preset number of trigger events on B has occurred

Time Delay Range: 200 ns to 1.6s
Resolution: 100 ns
Channel B Event Delay Range: 2 to 2^{24}-1, negative slope (maximum 20 MHz)

Statistics

Statistics may be applied to all measuring functions, with the exception of Manual Totalize and AC/DC Voltage. Statistics may also be applied on the result form Mathematics.
Max and Min: Displays maximum and minimum values of selected sample size
Mean and Std Dev: Displays calculated arithmetic mean and standard deviation of selected sample size
Sample Size: Default N = 100 or selectable between 1 and 65535 samples

Mathematics

Mathematics may be applied to all Measuring Functions. Volt A max/min is converted to Volt A p-p measuring function before mathematics is applied.
Formula: (K*X+L)/M or (K/X+L)/M, where X is current reading and K, L and M are selectable constants
K, L and M Constants: Set via keyboard, as frozen reference value from display (Xo) or as value form preceding measurement (Xn-1)

Other Functions

Measuring-Time: Single cycle, 0.8, 1.6, 3.2, 6.4, 12.8 µs and 50 µs to 20s (or to 400s for some functions and signals). The effective measuring time can be extended through multiple average measurements, using the Statistics function
Restart: Starts a new measurement, or data capture in Statistics mode
Local/Preset: Go to local functions in remote mode, or preset counter to factory default setting in local mode
Display Hold: Freezes measuring result, until a new measurement is initiated via Restart
Check: Applies 10 MHz Time Base Frequency to the measuring logic
Settings: 20 complete instrument settings can be saved and recalled from internal non-volatile memory. 10 memory positions can be user protected.
Menu: Display of all choices of Measuring Functions, Mathematics and Statistics

Input Channel Selection

A<=> B: Channels A and B are internally swapped

Display

Type: LCD with high-luminance backlight
Number of Digits: 10 digits plus exponent
Blanking: Insignificant digits can be blanked

Auxiliary Menu

An AUX MENU gives access to additional functions from the front panel (for example self tets). These functions can also be accessed via the GBIB interface.

Random Uncertainty

Random uncertainty is due to quantization error, internal and external noise. These effects are specified with their rms values; equal to the standard deviation (1 x 5).
The random uncertainty can be reduced to <1 x 10^{-10} or 100 ps as residual time uncertainty, by increasing the measuring time or by averaging over N cycles for time interval related functions.

Measurement Uncertainties

Measuring Functions	Total Uncertainty		LSD Displayed
	Total Random Uncertainty rms	Total Systematic Uncertainty	
Time Interval Pulse Width Rise and Fall Time	$\pm \frac{\sqrt{(350\text{ ps})^2 + [\text{Trigger Error}]^2}}{\sqrt{N}}$ (or minimum 100 ps)	± Trigger Level Timing Error ± 1.5 ns Systematic Error ± Time Base Error x Time Interval	$\frac{350\text{ ps} \times 2}{\sqrt{2N}}$
Frequency Period	$\pm \frac{\sqrt{(350\text{ ps})^2 + (\text{Trigger Error})^2}}{\text{Measuring Time}} \times \text{Freq. or Per.}$	± Time Base Error x Frequency or Period	$\frac{350\text{ ps} \times \sqrt{2}\ \text{Freq. or Period}}{\text{Measuring Time}}$
Ratio f_1/f_2	$\pm \frac{\sqrt{(\text{Prescaler factor})^2 + (f_1 \times \text{Trigger Error of } f_2)^2}}{f_2 \bullet \text{Measuring Time}}$		$\frac{\text{Prescaler Factor}}{\text{Measuring Time} \times f_2}$
Phase	$\pm \frac{\sqrt{(350\text{ ps})^2 + (\text{Trigger Error})^2}}{\sqrt{N}} \times \text{Freq.} \times 360°$ (or minimum 100 ps x Frequency x 360°)	± (Trigger Level Timing Error + 1.5 ns Systematic Error) x Frequency x 360°	0.01°
Duty Factor	$\pm \frac{\sqrt{(350\text{ ps})^2 + (\text{Trigger Error})^2}}{\sqrt{N}} \times \text{Frequency}$ (minimum 100 ps x Frequency)	± (Trigger Level Timing Error + 1.5 ns Systematic Error) x Frequency	1 x 10^{-6}

Table 1. Measurement Uncertainties and LSD Displayed. N = Number of samples averaged. Prescaler factor = 1 for inputs A and B.

PM 6680

Trigger Error

Trigger error is an input signal dependent random uncertainty caused by external and/or internal noise, thereby resulting in too early or too late start- and stop-triggering. The trigger error in start- and stop-trigger points respectively is expressed as an rms time error:

$$\frac{\sqrt{(\text{Vnoise-input})^2 + (\text{Vnoise-signal})^2}}{\text{signal slew rate (V/s) at trigger point}}$$

V/noise-input: 200 µV rms typical
V/noise-input: The rms noise of the input signal over a 225 MHz bandwidth.

Total trigger error (to be used in the formulas in table 1) is:

$$\sqrt{(\text{Start Trigger Error})^2 + (\text{Stop Trigger Error})^2}$$

Systematic Uncertainty

Systematic uncertainty can be measured and compensated for by inserting external delays or using internal math functions to provide nulling.

Trigger Level Timing Error

This timing error is due to trigger level setting error, input amplifier hysteresis and input signal slew rate and causes start- and stop- trigger level timing error.

Time Interval, Pulse Width, Rise and Fall Time, Duty Factor: x1 attention

$$\begin{aligned}&\pm\frac{0.02\text{V} + 1\%\text{ of set trigger level (V)}}{\text{Slew rate (V/s) at start trigger point}}\pm\\&\pm\frac{0.02\text{V} + 1\%\text{ of set trigger level (V)}}{\text{Slew rate (V/s) at stop trigger point}}\pm\\&\pm\left[\frac{0.015\text{V}}{\text{Slew rate (V/s) at start trigger point}}-\right.\\&-\left.\frac{0.015\text{V}}{\text{Slew rate (V/s) at stop trigger point}}\right]\end{aligned}$$

Phase: For sinewave signals >100 mV rms, trigger levels 0V and x1 attenuation settings (V pk in volt) ±[0.3/(V pk of A) + 0.3/(V pk of B)]° ± [1/(V pk of A) - 1/(V pk of B)]°

1.5 ns Systematic Error

The 1.5 ns Systematic Error is due to interchannel asymmetry and internal amplifier rise time and varies for the selection of measuring mode and input trigger settings. Typical error is <0.7 ns, (identical input signal, trigger level and slope in Time Interval A to B).

Time Base Error

See crystal oscillator specifications for ageing and possible frequency deviation due to the oscillator's temperature dependency.

LSD Displayed

Unit value of Least Significant Digit (LSD) displayed. After calculation, the indicated LSD values are rounded to the nearest decade before display (for example > 0.5 Hz will be 1 Hz and ≤ 0.5 Hz wil be 0.1 Hz). Measuring times >1s can give significance in> 10 digits. The 11th and 12th digits can be displayed by subtracting the two most significant digits using mathematics. LSD blanking is available to reduce displayed resolution. Up to 12 digits mantissa is available over the GPIB interface.

GPIB (Option PM 9626)

GPIB-Functions

Programmable Functions: All front panel accessible functions including AUX MENU
Compatibility: IEEE-488.2-1987, SCPI 1991.0
Interface Functions: SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, E2
Maximum Measurement Rate to Internal Memory: 200 to 2,000 readings/s, depending on measurement function and internal data format
Maximum Memory Size: 764 or 2600 readings, depending on measurement function and internal data format
Maximum Bus Transfer Rate: 150 to 1000 transfers/s, depending on internal data format and output data format
Data Output: ASCII, IEEE double precision floating point
Time Out: 100 ms to 25s or off

Crystal Oscillator Options

Model Options	/.1. Standard Version	/.2. Version PM 9678	/.4. Version PM 9690	/.5.Version PM 9691
Stability Against	Standard	TCXO	Oven	Oven
Aging: /24h /Month /Year	N/A $<5 \times 10^{-7}$ $<5 \times 10^{-6}$	N/A $<1 \times 10^{-7}$ $<5 \times 10^{-7}$	$<1.5 \times 10^{-9}$* $<3 \times 10^{-8}$ $<1.5 \times 10^{-7}$	$<5 \times 10^{-10}$* $<1 \times 10^{-8}$ $<7.5 \times 10^{-8}$
Temperature 0°C to 50°C ref. to +23°C	$<1 \times 10^{-5}$	$<1 \times 10^{-6}$	$<3 \times 10^{-8}$	$<5 \times 10^{-9}$
Line Voltage: ±10%	$<1 \times 10^{-8}$	$<1 \times 10^{-9}$	$<5 \times 10^{-10}$	$<5 \times 10^{-10}$
Warm-up time to reach 10^{-7} of final value	N/A	N/A	<15 min	<15 min

**After 48 hours of continuous operation*

Analog Output

An analog output voltage proportional to any consecutive 3-digits of the displayed measurement result (8-bit conversion) is supplied
Voltage Range: 0 to 4.98V in 20 mV steps
Output Impedance: 200Ω

General Specifications

Environmental Data

The PM 6680 is designed to meet MIL-T-28800D for Type III, Class 5, Style D
Temperature: Operating: 0°C to +55°C
Fan option PM 9628 is required when:
1. Ambient temperature >50°C or
2. Internal rack temperature >45°C; while mounted with no free air convection space and oven oscillator PM 9690 or PM 9691 is installed
Storage: -40°C to +70°C
Warm-up Time: <20 min
Reliability: MTBF 30000 h (calculated)
Safety: IEC 348 Class 1, CSA 22.2 No 231, EMC VDE 0871 Level B, FCC Part 15J Class A
Power Requirements: 90V rms to 265V rms, 45 Hz to 440 Hz, 30W

Mechanical Data

Size: 315 mm W x 86 mm H x 395 mm L (12.4 in H x 3.4 in H x 15.6 in L)
Weight: Net 3.7 kg (8 lb); Shipping 7 kg (15 lb)

Ordering Information

Model

PM 6680 225 MHz, 350 ps Timer/Counter

Included with Instrument

One-year product warranty, line cord, operator manual, and Certificate of Calibration Practices.

Input Frequency Option

PM 6680/0-- Standard 225 MHz
PM 6680/4-- 1.3 GHz Input C (PM 9621)
PM 6680/6-- 2.7 GHz Input C (PM 9624)
PM 6680/7-- 4.5 GHz Input C (PM 9625)

Reference Oscillator Option

PM 6680/-1- Standard Time Base
PM 6680/-2- TCXO (PM 9678B)
PM 6680/-4- Ovenized Oscillator (PM 9690)
PM 6680/-5- Very High Stability Ovenized Oscillator (PM 9691)
PM 6680/-8- Standard Time Base plus External Ref. Multiplier (1, 5, 10 MHz) (PM 9697)

Interface Option

PM 6680/--1 Standard Front Panel Control
PM 6680/--6 GPIB Interface (PM 9626)

Example, Ordering Configuration

To order the 225 MHz, 350 ps version with the TCXO frequency reference and GPIB interface, select:

		Model
Configuration		PM 6680
Option Suffix -	Input	/0--
	Oscillator	/-2-
	Interface	/--6
Yields Complete Model Number		PM 6680/026

Options and Accessories

PM 2255/001 Instrument Driver Software
PM 9585/01 50Ω Feedthrough Termination 1W
PM 9611/80 Rear Panel Inputs
PM 9621/00 1.3 GHz Input C
PM 9622/00 Rack Mount Kit
PM 9624/00 2.7 GHz Input C
PM 9625/00 4.5 GHz Input C
PM 9626/00 GPIB Interface
PM 9628/00 Cooling Fan (>50°C ambient)
PM 9629/80 TimeView Analysis Software
PM 9678B/01 TCXO Time Base
PM 9690/01 High Stability Oven Osc. Time Base
PM 9691/01 Very High Stability Oven Osc. Time Base
PM 9697/00 External Reference Multiplier (1, 5, 10 MHz)

When ordered together with the basic counter, options are factory installed. Options ordered separately can be customer retrofitted.

PM 9697 External Reference Multiplier can be used only with the Standard Time Base.

Manuals

PM 6680 Operator*
PM 6680 Program
PM 6680 Service

**No charge with purchase of unit*

Customer Support Services

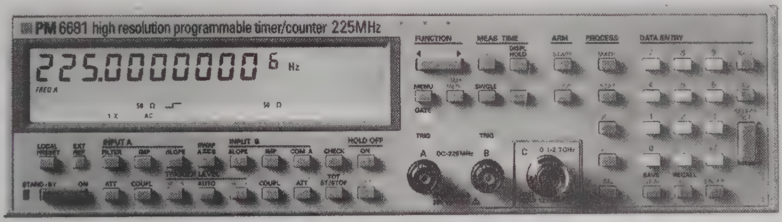
Also see Section 20.

Factory Warranty

One-year product warranty.

More Power to You!

NEW



Fluke PM 6681 Programmable Timer/Counter

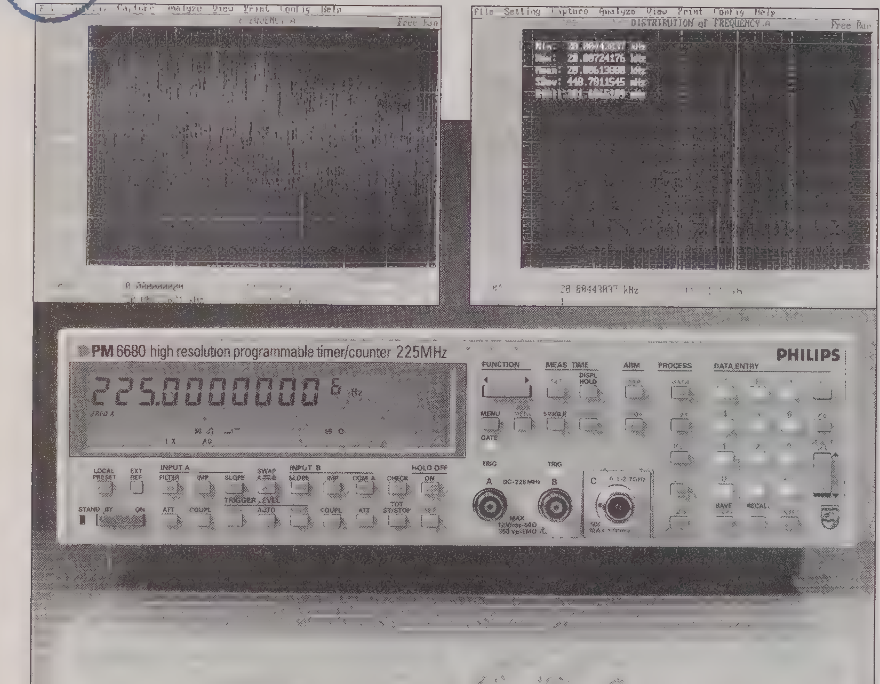
Preliminary Specifications

- 75 ps single-shot time resolution
- Up to 5,000 reading/s to internal memory
- 300 MHz input (1.3 GHz, 2.7 GHz or 4.5 GHz option)

The new PM 6681 can handle your most demanding applications with enhanced measurement speed and time resolution. Call now for the latest details. **Available Fall 1993**.

TimeView Software

NEW


File Setting Capture Analyze View Print Config Help
DISTRIBUTION of FREQUENCY A
Free Run
PM 6680 high resolution programmable timer/counter 225MHz
PHILIPS
225.0000000
FUNCTION
MEAS TIME
ARM
PROCESS
DATA ENTRY
INPUT A
INPUT B
TRIGGER LEVEL
HOLD OFF

Typical TimeView™, display and analysis screen displays.

Time & Frequency Analysis Software for PM 6680 Timer/Counter

- Simple, cost-effective analysis in the modulation domain
- Histograms for distribution analysis of signal jitter
- FFT of frequency variations for modulation analysis
- Display of frequency vs time with accurate cursor measurements
- Smoothing of jitter to reveal signal trends
- Stability parameters incl. standard deviation, root Allan variance
- Bring out the full power of your PM 6680

What is TimeView ?

TimeView is a software package that performs extensive time & frequency analysis in the modulation domain. It is designed for the high performance PM 6680 timer/counter to fully utilize its 350 ps resolution, 4.5 GHz bandwidth and the high 2000/s reading rate to internal memory.

The cost-effectiveness of a standard timer/counter for the data capture coupled with a PC for processing graphics display, brings you sophisticated time and frequency analysis performance at a low cost.

With TimeView you can discover things that you have never seen before, like VCO output frequency step response, frequency sweep characterization, hopping frequency transitions, unwanted line voltage modulation of oscillators, statistical jitter distribution and much more.

TimeView is much to the PM 6680 timer/counter as an oscilloscope is to a voltmeter – it interconnects thousands of instantaneous measurement results from the fast PM 6680 timer/counter, and shows graphically the measured values from the counter over time.

TimeView also incorporates powerful analysis modules.

The *statistical mode* processes the thousands of measurement results and gives deviation parameters and histograms showing the distribution pattern of the measured parameter. Time jitter and frequency instabilities can be quantified and analyzed.

The *FFT* mode analyzes deviations of the measured value to detect and characterize the deviations. Systematic (cyclic) deviations caused by modulation, are detected and quantified.

Instrument Control

The PM 6680 timer/counter is controlled from the TimeView screen. All major functions, such as measuring functions and input settings, can be set quickly and easily. More advanced settings such as arming with delay and trigger hold-off, delayed by event counts, can also be set from TimeView.

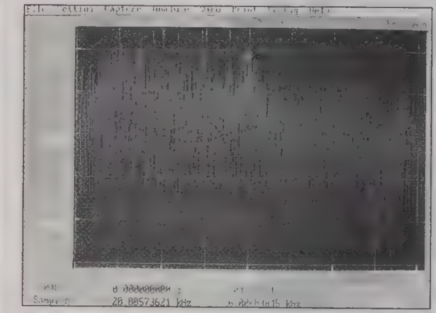

File Setting Capture Analyze View Print Config Help
20.00573621 kHz

Fig. 1. Shows the variation over 2s of a 20 kHz square wave output from a pulse generator. 2048 samples are shown in the graph. This graph gives a visual impression of generator stability. Max. and min. deviations can be estimated.

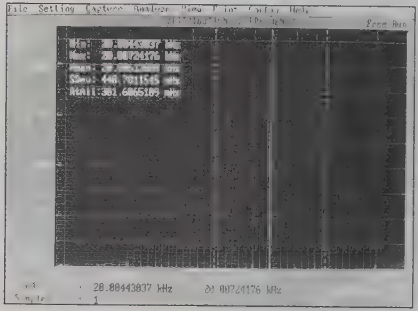

File Setting Capture Analyze View Print Config Help
Free Run
20.00443037 kHz
20.00724176 kHz

Fig. 2. Shows distribution histogram of the 2048 measurements of fig. 1 divided over 50 bins and provider statistical key parameters. Here the instability can be quantified in terms of RMS-jitter, root Allan variance and peak deviations.

A *measurement read-out mode*, lets you view your measuring results "on-line" on the TimeView display screen.

A *signal read-out mode* helps you in setting up the counter by displaying waveform period, and width plus minimum and maximum voltage levels.

TimeView Software

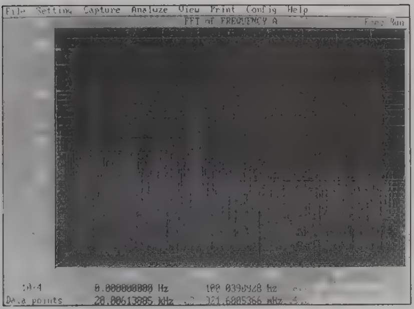


Fig. 3. Shows FFT analysis of the data in fig. 1. This graph reveals frequency modulation due to insufficient regulation of the 50 Hz power supply. The main interference source is detected and corrective actions may be taken to improve design.

Data Capture

TimeView supports several data capture modes.

Free-running measurements are made as fast as the counter allows. Frequency and period values are sampled up to 2000 times/s.

Repetitive sampling measurements are much like the repetitive sampling mode of a sampling oscilloscope. This mode is used to achieve a virtual 10M samples/s sampling rate of repetitive phenomena. Just like a sampling oscilloscope, you need a unique trigger point of your signal or an external trigger (arming) signal for synchronization.

View of Captured Data

TimeView automatically displays captured data as a function of time to visualize dynamic time & frequency variations. Long-term ageing and drift can be measured over weeks, whereas jitter and short-term instabilities, including modulation, can be measured over milliseconds.

Graph cursors let you easily select and view the numeric values of each individual measurement. Delta measurements let you easily see the difference between measured values in different parts of the graph.

Data between the two graph cursors can be zoomed in to expand interesting parts of your captured signal. For example, fig. 5 shows the frequency step response from a VCO, and at the same time the "frequency rise-time".

Mathematical smoothing can remove jitter from the signal to show signal trends like thermal drift or ageing.

Analysis

TimeView offers additional powerful tools for analysis that let you perform time & frequency analysis in the modulation domain like never before. It is an ideal tool for testing oscillators and synthesizers in signal generators, transmitters and receivers, covering a frequency spectrum from DC up to 4.5 GHz.

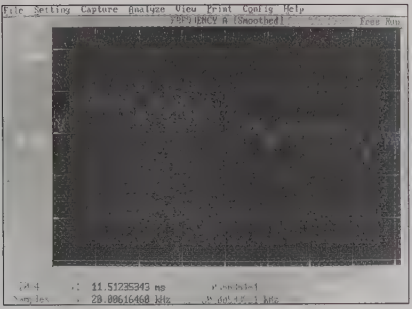


Fig. 4. Smoothing of raw data from fig. 1 clearly shows underlying trends.

Statistical Mode

TimeViews statistical mode processes the thousands of measurements and gives key deviation parameters like max., min., mean value, standard deviation and root Allan variance as measures of RMS-jitter, peak deviations or short-term instability.

Histograms show the distribution pattern of all measurements, with markers for the mean value and standard deviation. Histogram analysis shows whether deviations are systematic or random and if they possibly could be eliminated by finding the influence sources for these deviations.

FFT Mode

Like an FFT analyzer it shows the spectral density of voltage variations, the unique FFT mode in TimeView shows spectral density of frequency variations, in other words - modulation. You can analyze FM signals or find and quantify unwanted modulation on signals that are supposed to be stable. It is an ideal tool for finding imperfections in PLL control systems and for detecting unwanted modulation of an oscillator caused by, for instance, insufficiently stabilized supply voltage.

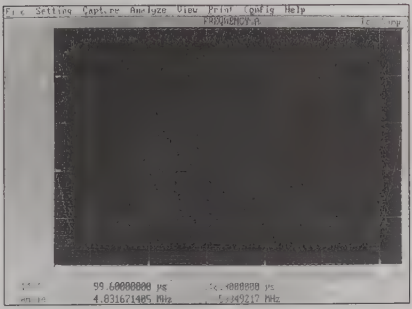


Fig. 5. TimeView is an ideal tool for analyzing a VCO output frequency transient. This graph was created using repetitive sampling data capture mode with 100 ns between successive samples. Note the slight "frequency over-shoot" and the frequency rise time of approx 20 µs.

File Storage

Captured data can be stored on disk for later analysis. You can analyze measurement data off-line with TimeView, even with no counter attached. TimeView stores data in a straight forward ASCII format which makes it easy to import data into other programs such as spreadsheets.

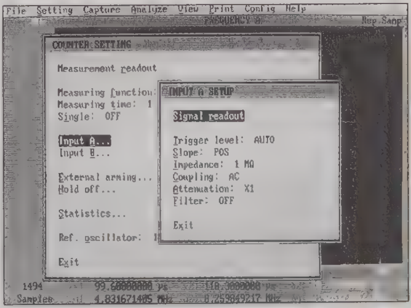
Counter settings may also be stored for fast setup and repeatable tests.

Easy to Use

TimeView is designed around a state-of-the-art user interface, employing pull-down menus and pop-up windows, which make learning easy. A getting started section in the TimeView manual gets you up and running within a few minutes. Context sensitive help functions are available.

TimeView also features short-cut keys for immediate execution of commonly used functions. You can, for example, capture a block of data, perform an FFT and print the result with only three keystrokes.

And programming of the PM 6680 timer/counter is very easy using pull-down menus and pop-up windows. There is no need to remember a lot of programming codes. Just make your choice from the list of measuring functions or just fill in desired values such as trigger levels in the pop-up window.



COUNTER SETTING

Measurement readout

Measuring function:
Measuring time: 1
Single: OFF

Input A...
Input B...

External arming...
Hold off...

Statistics...

Ref. oscillator:

Exit

INPUT A SETUP

Signal readout

Trigger level: AUTO
Slope: POS
Impedance: 1 MΩ
Coupling: AC
Attenuation: X1
Filter: OFF

Exit

Fig. 6. State-of-the-art user interface employs pull down menus and pop-up windows boxes, all of which makes TimeView very easy to learn and use.

TimeView Software

Specifications

Technical Specifications

System Requirements

Computer: IBM PC/AT or compatible, with at least 640 KB of memory and DOS 3.30 or above.
Monitor: VGA/EGA, monochrome or color
GPIB Interface Card: Philips PM 2201, National Instruments PC-IIA or Capital Equipment Corp.
Printer: IBM Proprinter or HP Laserjet (for printing of graphs)
Timer/Counter: Philips PM 6680 with GPIB interface
Diskette Format: Both 3.5 inch (720 KB) and 5.25 inch (1.2 MB) diskettes are supplied.

Data Capture Modes

- Free running measurements
- Repetitive sampling data

Max. Samples/s in Free Running Mode

Frequency/Period: 2000 samples/s
Ratio: 2000 samples/s if sample size <764 and 650/s if sample size >764
Time Interval/Pulse Width/Rise Time: 1300 samples/s if sample size <764 and 500 samples/s if sample size >764.
Phase/Duty Factor: 200 samples/s

Max. (Equivalent) Sample Rate in Repetitive Sampling Mode: Up to 10 MHz

Data Analysis Features

- Time variation graph (measurement data vs time)
- Smoothing in time variation graph
- Distribution histogram
- Statistics parameters: max., min., mean, standard deviation, root Allan variance.
- FFT graph
- Cursor zoom and cursor measurements in all graphs

Sample Size

Max. 2048 measurements

Ordering Information

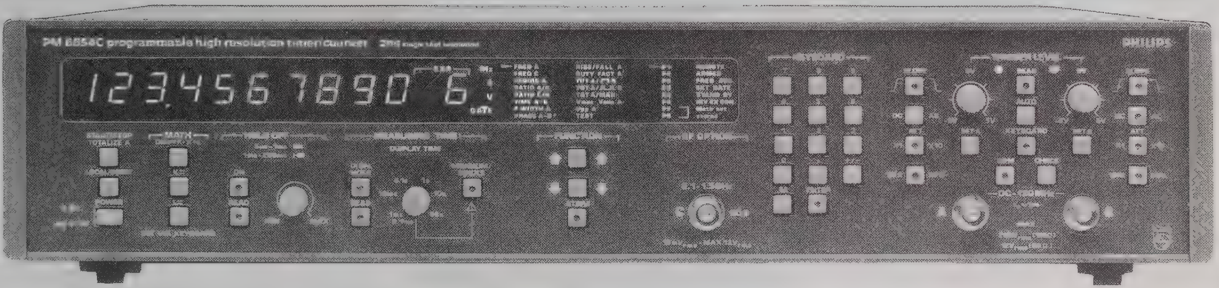
Model

PM 9629/80 TimeView SW including operators manual
PM 2201/98 GPIB Interface for PC

The following trademarks and registered trademarks are acknowledged:
HP Laserjet : Hewlett Packard
IBM PC/AT, VGA, EGA, Proprinter : International Business Machine Corporation
MS-DOS : Microsoft Corporation

PM 6654C & PM 6652C

GPIB
IEEE-488



(NSN 6625-01-314-8685) **PM 6654C**

PM 6654C & PM 6652C System Timer/Counters

- High accuracy FREQUENCY and PERIOD measurements of 9 digits in one second
- High sensitivity 1.5 or 2.3 GHz inputs with wide 10 mV rms to 12V rms dynamic range
- TIME-INTERVAL resolution down to 0.5 ps averaged and 2 ns single shot
- Measuring modes incl.: Phase, Rise/Fall Time, Duty Factor, V max/min/p-p of input
- 8 pre-programmable front panel menus: digital readout of trigger levels
- Mathematical functions
- Trigger facilities include Arming, Hold-Off, External Gating and Auto Triggering Level

Introduction

PM 6652C and PM 6654C high performance, fully programmable timer/counters satisfy virtually all frequency and time measurement requirements, especially in R & D laboratories and automatic test systems applications.

The measuring functions and appearance of both instruments are the same. The difference is found in resolution, accuracy and measuring speed. The PM 6652C has a 10 MHz (100 ns) clock frequency, whereas the extra high resolution PM 6654C features a 500 MHz (2 ns) realtime clock resolution. Thanks to its short measuring cycle times, the extra high resolution PM 6654C is particularly well suited to high speed automatic test systems. Both the PM 6652C & 6654C timer/counters offer 14 frequency, time and voltage measuring modes, 100% GPIB/IEEE-488* bus programmability, over 400 readings/second bus speed, 2 ns single shot resolution and 2.3 GHz frequency range.

High Time Interval Measuring Accuracy

A unique combination of high resolution, high trigger accuracy and special trigger control facilities puts these instruments among the most powerful timers on the market.

The high technology PM 6654C with its 2 ns single shot resolution allows time interval measurements to be made to an accuracy and resolution well beyond those of normal timer/counters.

Repetitive signals allow significantly improved resolution by averaging of measuring results. Time intervals, pulse widths, rise and fall times can be measured this way down to sub-picosecond resolution with the PM 6654C and down to 10 ps resolution with the PM 6652C.

Powerful FREQUENCY Measuring Capabilities

High accuracy FREQUENCY and PERIOD measurements can be made in a one second measuring time with resolution of 9 digits in the PM 6654C and 7 digits in the economy version PM 6652C. Both models perform advanced frequency measurements, including externally gated frequency measurements, burst frequency and multiple burst frequency average measurements on down to 200 ns narrow bursts (500 ns for PM 6652C).

Trigger HOLD-OFF, when activated in the FREQUENCY and PERIOD modes, acts as a digital low-pass filter to ignore noise and interference, thereby preventing erroneous measurements.

Complete Triggering Capability

Ultimately, no timer measures more accurately than its trigger accuracy. The PM 6652C's and PM 6654C's inputs therefore features very fast 1 ns rise time and 20 mV rms, sensitivity over a -5V to + 5V dynamic range, Trigger level accuracy is assured by digital setting and display with 10 mV resolution.

The trigger level may be set by knob controls, keyboard entry, or automatically. In the AUTO mode the counters automatically set A and B trigger levels to 50% of input signal amplitude or 10% and 90% for rise/fall time measurements.

Automatic hysteresis compensation ensures that the actual triggering occurs at the set trigger level and is not delayed by the input hysteresis. Arming and trigger hold-off enable unwanted signals to be ignored.

Mathematics

The MATH (mathematics) facility allows scaling and/or off-setting of measured results before display. This significantly extends the range of application by enabling calibration or unit conversion.

Powerful IEEE-488 Bus Capabilities

Both the PM 6652C and PM 6654C are fully programmable, including all front-end controls and trigger level voltages. Advanced software features are available, including bus learn mode and programmable delimiters. In addition, the high-speed dump mode allows the user to fully exploit the high resolution/high-measuring speed of the PM 6654C, allowing up to 400-500 measurements per second. Pre-set limit monitoring is another useful feature, allowing the counter to send an SRQ when low or high limits are exceeded.

---

* *The terms GPIB and IEEE-488 may be used interchangeable throughout this catalog.*

PM 6654C & PM 6652C

Specifications

Measuring Functions

Frequency A

Range
PM 6652C: 0.1 Hz to 120 MHz
PM 6654C: 0.01 Hz to 120 MHz

Frequency C Optional

Range: 100 MHz to 1.5 GHz (Option PM 9610)
Range: 100 MHz to 2.3 GHz (Option PM 9619)

Period A

Range
PM 6652C: 100 ns to 10^{10}s, resolution 100 ns
PM 6654C: 8 ns to 10^{10}s, resolution 2 ns

Time Interval A to B, Pulse Width A, Rise/Fall A; Single

Range
PM 6652C: 100 ns to 10^{10}s, resolution 100 ns
PM 6654C: 8 ns to 10^{10}s, resolution 2 ns

Time Interval A to B, Pulse Width A, Rise/Fall A; Averaged

Range
Time Interval: 0 ns to 100s
Pulse Width: 4 ns to 100s
Rise/Fall Time: 8 ns to 100s

Resolution
PM 6652C: $(100\text{ ns})/\sqrt{N}$
PM 6654C: $(10\text{ ns})/\sqrt{N}$

Duty Factor A

Range: 0 to (1 - 250 ns x Pulse rep. rate)
Frequency Range: 0.03 Hz to 2 MHz

Totalize A

Range: 1 to 10^{18}
Frequency Range: 0 to 120 MHz
Mode: Manual or external

Ratio A/B

Range: 10^{-9} to 10^{10}
Frequency Range: 0.1 Hz to 120 MHz/0.01 Hz to 10 MHz

Ratio C/B

Range: 10 to 10^{11}
Frequency Range: Input C range/0.01 Hz to 10 MHz

Phase A-B

Range: 0° to 360° / (1 - 250 ns x FREQ)
Frequency Range: 0.03 Hz to 2 MHz

V Max, V Min, V p-p

Range: -50V to +50V
Frequency Range: DC, 100 Hz to 120 MHz

Input and Output Specifications

Inputs A and B

Frequency Range: DC-coupled: 0 to 120 MHz; AC-coupled: 20 Hz to 120 MHz
Rise Time: Approx 1 ns
Sensitivity: 20 mV rms sinewave or 60 mV p-p (0 to 60 MHz); 30 mV rms sinewave or 90 mV p-p (60 MHz to 120 MHz)
Min. Pulse Duration: 4 ns
Attenuation: x 1, x 10 (fixed)
Hysteresis Band: Approx. 40 mV p-p
Hysteresis compensation is automatically performed in TIME A-B, P Width A, RISE/FALL a, PHASE A-B and DUTY FACTOR measuring modes; resulting in a residual hysteresis band which is virtually 10 mV p-p.
Dynamic Input Voltage Range: 60 mV p-p within ±5V p-p ±5V dc (x 1);600 mV p-p within ±50V p-p 50V dc (x 10)
Trigger Level Selection: Manually via keyboard (10 MV steps); Manually via potentiometers; Auto trigger
Trigger Level Range: -5V to +5V (x 1); -50V to +50V (x 10)
Trigger Slopes: Positive or negative
Trigger Level Readout: Set trigger levels for channel A and B are displayed with a resolution of 10 mV (x 1) or 100 mV (x 10)
Trigger indicators: Tri-state LED indication
AUTO Trigger: The AUTO trigger will automatically set A and B trigger levels to 50% of input signal amplitude (10% and 90% for rise/fall time measurements).
***Min. Amplitude:** 120 mV p-p*
***Frequency range:** 100 Hz to 120 MHz*
Coupling: DC/AC
Channel Input: Separate A and B or common via A

Impedance

Separate A and B: 1 MΩ/35 pF or 50Ω nominal (A and B);
Common A: 0.5 MΩ/70 pF nominal or 50Ω nominal (A). Open input (B).

Input C (Option/PM 9610)

Frequency: 100 MHz to 1.5 GHz
Operating Input Voltage Range: [10 mV rms to 12 mV rms (100 MHz to 1 GHz); [30 mV rms to 12 mV rms (1 to 1.5 GHz)
Coupling: AC
Impedance: 50Ω nominal; VSWR ≤2
AM Tolerance: 98%; minimum signal must exceed minimum operating input voltage
Max Voltage Without Damage: 12V rms; overload protection with PIN diodes

Input C (Option PM 9619)

Frequency Range: 0.1 to 2.3 GHz
Coupling: AC
Operating Input Voltage Range:
20 mV rms to 12V rms; 100 to 300 MHz
10 mV rms to 12V rms; 0.3 to 2 GHz
15 mV rms to 12V rms; 2 to 2.1 GHz
25 mV rms to 12V rms; 2.1 to 2.3 GHz*
AM Tolerance: 94% at max 100 kHz modulation frequency. Minimum signal must exceed minimum operating input voltage requirement.
Input Impedance: 50Ω nominal
VSWR: <2.0:1; 50 to 1500 MHz
<2.5:1; 1.5 to 2 GHz
<3.5:1; >2 GHz
Max Voltage Without Damage: 12V rms; overload protection with pin diodes Rear Panel Inputs and Outputs

Rear Panel Inputs and Outputs

Input D: 100 kHz to 10 MHz external reference frequency
Input E: External reset
Input F: External arming, external gate or average
Output G: 10 MHz internal reference frequency
Output H: Gate open/closed output signal
Output I and J: Channels A and B trigger levels

Crystal Oscillator Summary

PM 66../ to Version Including Time Base Option	**/.1. Standard Version**	**/.2. Version PM 9678B**	**/.4. Version PM 9690**	**/.5.Version PM 9691**
Stability Against	Standard	TCXO	Oven	Oven
Aging: /24h /Month /Year	N/A <5 x 10^{-7} <5 x 10^{-6}	N/A <1 x 10^{-7} <5 x 10^{-7}	<1.5 x 10^{-9}* <3 x 10^{-8} <1.5 x 10^{-7}	<5 x 10^{-10}* <1 x 10^{-8} <7.5 x 10^{-8}
Temperature: 0°C to 50°C Ref. to +23°C	<1 x 10^{-5}	<1 x 10^{-6}	<3 x 10^{-8}	<5 x 10^{-9}
Change in supply mode: line/int battery/ext DC 12V to 28V	<3 x 10^{-7}	<5 x 10^{-8}	<3 x 10^{-9}	<3 x 10^{9}
Line Voltage: ±10%	<1 x 10^{-8}	<1 x 10^{-9}	<5 x 10^{-10}	<5 x 10^{-10}
Warm-up time to reach 10^{-7} of final value	N/A	N/A	<15 min	<15 min

After 48 hours of continuous operation

GPIB/IEEE-488 Bus

All front panel accessible functions are programmable through the option PM 9696B.
Date Output Rate: 30 to 50 readings/s in normal mode, approx. 420 readings/s in high speed dump mode.

General Specifications

Measuring Time: 0.1 ms to 96s, down to approx, 2 µs for single events measurements or external gate
Display hold: Freezes measuring result
Trigger Hold Off Range: 5 µs to 200 ms (manual setting)
Time Interval Delay: 100 µs to 99s; bus programmable Hold -off active in single-shot Time Interval, Pulse width or Rise/Fall Time measurement.
Mathematics: Mathematics makes it possible to offset a measuring value or to change scale factor as follows: KX+L.
Check: Applies 10 MHz Time Base Frequency to the measuring logic
Reset: Manual via push-button or electrical via input E
Power On/Stand By: In "ST BY" position, power is available to maintain an ovenized crystal oscillator
Test Function: Performs internal self test
Program Memory: 8 complete instrument settings can be saved and recalled from internal non-volatile memory
Display: 10 digits LED display, sign and exponent
Unit Indicators: 3 LEDs indicating Hz, s or V
Operating Temperature: -5° C to 50° C
Power Requirements: 115/230V±15%, 45 to 440 Hz; 60 VA. The PM 6652C and PM 6654C can also be powered by an external dc voltage; 17V to 29V.
Size: 440 mm W x 89 m H x 440 mm L (17.3 in W x 3.5 in H x 17,3 in L)
Weight: Net, 8 kg (17.5 lb); shipping, 10 kg (22 lb)

Ordering Information

Models

PM 6652C 120 MHz, 100 ns Timer/Counter
PM 6654C Plus 2 ns resolution

Included with Instrument

One-year product warranty, line cord, rack mounting brackets, Operating manual, and Certificate of Calibration Practices.

Optional Configurations

When ordering, select basic "PM" Model desired from above, plus construct a 3-digit /suffix by selecting 1 digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface.

Input Frequency Option

/0-- Standard 120 MHz
/5-- 1.5 GHz (PM 9610/01)
/6-- 2.3 GHz (PM 9619)

Reference Oscillator Option

/-1- Standard Crystal
/-2- TCXO (PM 9678B/01)
/-4- Very High Stability Ovenized Crystal (PM 9690/01)
/-5- Ultra High Stability Ovenized Crystal (PM 9691/01)
/-8- Standard Crystal plus Externally Referenced Frequency Multiplier (PM 9697/00)

Interface Option

/--1 Standard Front Panel Control
/--2 Blind Panel Version with GPIB IEEE-488 I/F (PM 9696B/00)
/--5 Standard Front Panel with Analog Recorder Output (PM 9695/00)
/--6 Standard Front Panel with GPIB IEEE-488 I/F (PM 9696B/00)

Example, Ordering Configuration

To order the 120 MHz, 100 ns resolution version with TCXO oscillator and standard front panel with GPIB IEEE-488 I/F, select:

		Model
Configuration		PM 6652C
Option Suffix -	Input	/0--
	Oscillator	/-2-
	Interface	/--6
Yields Complete Model Number		PM 6652C/026

Options and Accessories

PM 9585/01 50Ω Feedthrough Termination; 1W
PM 9610/01 1.5 GHz Option (input C)
PM 9611/01 Built-in Rear Panel Input Wiring Option
PM 9612/01 Fan
PM 9613/01 Rack Mount Slide Kit
PM 9619 2.3 GHz Option (input C)
PM 9665B/01 50 kHz Low Pass Filter
PM 9666/01 Trigger Level Output Cable
PM 9678B/01 TCXO Time Base Oscillator (version/.2.)
PM 9690/01 Ovenized Time Base Oscillator (version/.4.)
PM 9691/01 Ovenized Time Base Oscillator (version/.5.)
PM 9695/00 Analog Recorder Output
PM 9696B/00 IEEE-488 Bus Interface
PM 9697/00 External Reference Frequency Multiplier

The time base oscillators PM 9678 to PM 9691 can also be ordered separately for later upgrading of the counters.

The PM 9611 option is not customer retrofittable, but must be ordered factory installed. The PM 9697 multiplier can be installed only in the /-1- versions.

Older versions of bus interface, PM 9696 without "RTL-update," cannot be used in a PM 6652C or PM 6654C.

Manuals

PM 6652/54 Pocket Guide
PM 6652/54 Operator*
PM 6652/54C Service

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

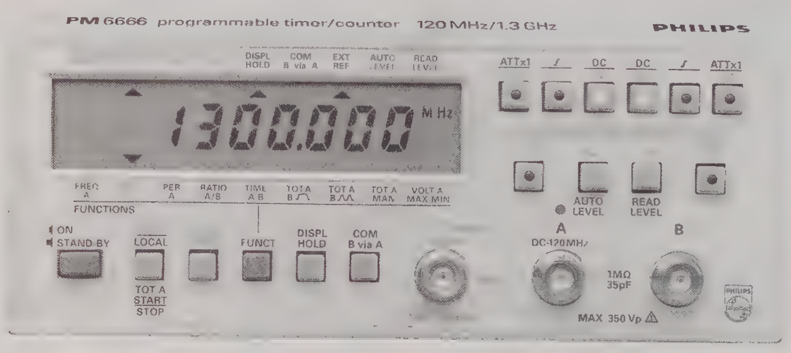
Factory Warranty

One-year product warranty.

PM 6665 & PM 6666

GPIB IEEE-488

Available through Distributors



PM 6666

PM 6665 & PM 6666 Programmable Timer/Counters

- Unrivalled price/performance
- High resolution reciprocal counting
- High trigger accuracy
- PM 6666: Full GPIB/IEEE-488 programmability, Auto Trigger, Voltage Measurements
- PM 6665: Continuously variable sensitivity, HF filter
- High stability MTCXO: 2 x 10^{-7} over 0°C to 50°C – pushbutton calibration
- 9 measuring modes including high resolution time-interval average
- 120 MHz/1.3 GHz option

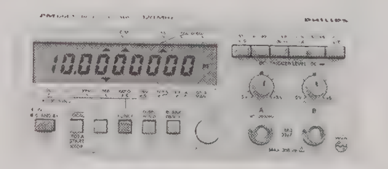
Introduction

The PM 6665 and PM 6666 are very versatile timer/counters with many functions included as standard, spanning frequencies from 0.1 Hz to 120 MHz, and optionally up to 1.3 GHz. The measuring functions include FREQUENCY, PERIOD, FREQ RATIO, TOTALIZE pulses, TIME INTERVAL, RPM (PM 6665) and VOLT peak values (PM 6666).

The units have a built-in microprocessor that uses the reciprocal frequency counting technique, which yields high resolution measuring results under all conditions, even on low frequency measurements.

Measuring accuracy is increased by the high performance counter front-ends, providing variable sensitivity and noise immunity. Accuracy can be further improved with the optional high stability time-base.

Both units provide unmatched value for money and offer a high degree of programmability through the GPIB/IEEE-488* interface. All major functions can be programmed with the PM 6665; and the PM 6666 offers 100% programmability including trigger level and sensitivity settings.



PM 6665

PM 6665

The PM 6665 timer/counter is specifically designed for applications with a small budget but a demand for a broad range of high performance counting and timing. It is low cost and offers the same high quality as other Fluke test and measurement instruments. For example:

- Design is highly integrated, ensuring reliable, low power operation.
- Time base stability is exceptional with the MTCXO (mathematically temperature compensated crystal oscillator), which delivers stability comparable to that of costly oven stabilized oscillators at the price level of a conventional TCXO.
- An all-metal cabinet gives excellent RFI shielding and mechanical stability.
- The PM 6665 offers the best solution for both frequency and time measurements with its high quality inputs. Frequency measurements have continuously variable sensitivity and noise immunity and time measurements can be triggered within a wide ±5V/±50V range. A noise rejection filter is included as standard, and digit blanking can be used to remove irrelevant or unstable digits from the display.

Optimal Time Measurements

The inputs for time measurements in the PM 6665 incorporate high speed synchronizers and equalized input channels to eliminate differences in delay and risetime. High sensitivity inputs reduce the possibility of trigger errors; trigger levels can be selected in the range from -50V to +50V and trigger indicators simplify level setting.

Frequency Measurements

Frequency measurements must have a variable noise immunity – which in practice means variable sensitivity – for correct triggering. On the PM 6665 this is accomplished with the continuously variable x1 to x100 input signal attenuator.

Noise Rejection Filter Standard

The built-in noise rejection filter is useful for cleaning up noisy LF signals and for filtering off HF noise, even at levels higher than the input signal.

PM 6666

The PM 6666 is the first low cost timer/counter with high accuracy frequency, time and voltage measurements that also offers 100% programmable GPIB/IEEE-488 operation. With the GPIB/IEEE-488 bus, all measurement functions including trigger level settings and sensitivity can be programmed. A bus learn mode is provided to speed and simplify programming.

The PM 6666 is also an excellent all-purpose instrument for bench-top use, with 9 front panel selectable measuring functions including voltage max./min. measurements.

Bus time-out and separator settings are also programmable on both the PM 6665 and PM 6666 and a high speed mode delivers high-speed output of unformatted data at over 100 measurements/s. An optional rack mount adapter is available for both units for integration into measuring systems.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 6665 & PM 6666

Error-Free Triggering

Triggering is error-free on the PM 6666 for all waveforms. Trigger-level setting can be automatic on all input signals over 100 Hz. Resolution is 20/200 mV, over a very wide range (-50V to +50V) that allows measurements to be accurate even on high voltage events. The trigger level can be displayed immediately with one keystroke; and inputs can be instantly checked for triggering with the tri-state LED trigger indicators.

To give the various noise immunity settings, input sensitivity has six steps, from 20 mV to 1V rms.

Peak Voltage Measurements to 50 MHz

The PM 6666 has a unique capability for an instrument in this price range, i.e., Volt peak measurements (-50V to +50V) at up to 12 MHz at an error level of no more than a few percent. Vpeak measurements are possible over the range 12 MHz to 50 MHz with slightly higher errors. When displaying Vmax./min. measurements, positive and negative signal peaks of the input signal are shown simultaneously with a resolution of 20/200 mV.

PM 6665 & PM 6666; Leading Technology

The latest technology is used in these timer/counters to give them their unrivalled performance for instruments in their price class.

Special emphasis was placed on reliability and integration to decrease the component count, which reduces heat dissipation and gives a high MTBF figure. For example, the entire counting logic circuitry consists of just two chips – the LSI counter-on-a-chip and a single chip control microcomputer. Also, a unique crystal oscillator is used for the timebase facilities – the MTCXO (see below). All this combines to give very powerful instruments in a small package and low price.

The PM 6665 and PM 6666 have high input protection, allowing them to withstand inputs of 12V rms on the optional 50Ω RF input, and 350V (dc + ac peak) on the 1 MΩ LF input.

Unique MTCXO Time Base

Until now, choice of the time base crystal oscillator, which determines the final accuracy of the counter, was only between the low-cost uncompensated standard crystal oscillators, medium price TCXOs (temperature compensated crystal oscillators) and high price, high stability oven-controlled oscillators.

Now, Fluke has developed a mathematically compensated crystal oscillator which costs the same as a normal TCXO yet has a stability of 2×10^{-7} (0°C to 50°C), comparable with that of an oven stabilized oscillator.

This new oscillator is called the MTCXO or Mathematically Temperature-Compensated Crystal Oscillator. It has an associated non-volatile memory in which are stored the frequency deviations from the factory measured temperature dependent frequency curve, at each temperature. During a measurement, the temperature of the crystal is measured, the deviation for that temperature is retrieved from the memory and the result is automatically compensated before display. In addition, because the temperature of the crystal is always compensated for each measurement, no warm up time is required for high accuracy measurement. Calibration is performed with the touch of a button, without warm-up.

High Resolution

Both the PM 6665 and PM 6666 can measure low frequency signals to high resolution with synchronized multiple period measurements and computing the reciprocal values.

Resolution is at least 7 digits on a 1s measuring time, because the traditional ±1 input cycle error is eliminated by the built-in microprocessor. This high resolution applies to all input frequencies, whether high or low. Thus long gate times are no longer needed to obtain high resolution when measuring low frequency input signals. There is also no risk of instrument rounding error, because of the full 9-digit display.

Time interval measurements are high resolution as well as high accuracy, due to the time interval averaging technique. The 100 ns resolution is improved by a factor $\sqrt{N}$ (N = number of time intervals averaged) when compared with single time interval measurements. The maximum obtainable N is 4×10^7, resulting in a resolution of better than 20 pico seconds.

Versatility for All-Purpose Use

Several variations and options are available so the user can chose exactly the configuration required for his application. The options are factory installed and tested in each user configuration. However, all options can also be field installed by the user allowing upgrading of the counter at any time. The full range comprises:

- GPIB/IEEEE-488 interface
- Highly stabilized time base (MTCXO)
- 1.3 GHz HF input
- Battery power pack
- Rack mount kit
- Carrying case

Specifications

Measuring Functions

Frequency A or C
(frequency B via GPIB/IEEE-488 only)

Range
Freq A: 0.1 Hz to 120 MHz: typically to 160 MHz
Freq B: 0.1 Hz to 12 MHz (via GPIB/IEEE-488 only)
Freq C: 70 MHz to 1.3 GHz (optional)

Mode: Reciprocal frequency counting
LSD Displayed:

$$\frac{2.5 \times 10^{-7} \times \text{FREQ}}{\text{measuring time}}$$

RPM A (PM 6665 only)

The FREQUENCY A measurement is taken, multiplied by 60 and shown on the display as revolutions per minute (rpm)
Range: 6 rpm to 720×10^6 rpm

Period A

Range: 8 ns to 2×10^8s
Mode: Single period measurement (SINGLE) or average period measurement (at 0.2s, 1s or 10s measuring times)
LSD Displayed: SINGLE period measurement: 100 ns (TIME <100s); average period measurement:

$$\frac{2.5 \times 10^{-7} \times \text{PERIOD}}{\text{measuring time}}$$

Ratio A/B (ratio B/A, C/A or C/B via GPIB/IEEE-488 only)

Range: 1×10^{-7} to 2×10^9 (A/B); 1×10^{-8} to 2×10^8 (B/A); 0 to 1×10^{15} (A/B SINGLE and B/A SINGLE); 8 to 6×10^{10} (C/A, C/B)

Frequency Range
Input A: 0 MHz to 120 MHz (A/B); 0 MHz to 12 MHz (B/A, C/A, A/B SINGLE)
Input B: 0 MHz to 12 MHz
Input C: 70 MHz to 1.3 GHz

Time Interval A/B (time interval B-A via GPIB/IEEE-488 only)

Range: 100 ns to 2×10^8s (SINGLE); 0 ns to 20s (average)
Mode: Single time interval (SINGLE) for time interval measurements (at 0.2s, 1s or 10s measuring times)
LSD Displayed: SINGLE time interval measurement: 100 ns (TIME <100s); Average time interval measurements:

$$\frac{2.5 \times 10^{-7}\text{s}}{N}$$

Averaged Number of Intervals N:

$$\frac{\text{measuring time}}{\text{pulse repetition time}}$$

Note: Input signals must be repetitive and asynchronous with respect to the time base.

Min Dead Time from Stop to Start: 250 ns
Timing Difference A-B Channels: 4 ns max

Totalize A (totalize B via GPIB/IEEE-488 only)

Range: 0 to 1×10^{15} with indication of k or M (kilopulses or Megapulses) the result is truncated if out of display range
Frequency Range: 0 Hz to 12 MHz
Pulse Pair Resolution: 80 ns
LSD Displayed: 1 unit count (counts $<10^9$); 5x counts/10^9 (counts $\geq 10^9$)
Gated by B (A) Mode: Event counting on input A (B) during the duration of a pulse on input B (A)
Start/Stop by B (A) Mode: Event counting on input A (B) between two consecutive pulses on input B (A)

PM 6665 & PM 6666

Manual Mode: Event counting is controlled by the START/STOP button. Sequential start-stop counts are accumulated. RESET closes the gate and resets the timer/counter to zero.

Volt Max/Min A (PM 6666 only; volt max/min B via GPIB/IEEE-488 only)

Range: -51V to +51V
Frequency Range: DC and 100 Hz to 50 MHz (input A); dc and 100 Hz to 5 MHz (input B)
Resolution: Input signals within ±5V, 20 mV; input signals outside ±5V, 200 mV
Inaccuracy DC and 100 Hz to 12 MHz (A), or to 1 MHz (B): Input signals within ±5V, 30 mV ±1% of reading ±3% of V p-p; input signals outside ±5V, 300 mV ±3% of reading ±3% of V p-p
Inaccuracy 12 MHz to 50 MHz (A) or 1 MHz to 5 MHz (B): Input signals within ±5V, 30 mV ±10% of reading ±10% of V p-p; input signals outside ±5V, 300 mV ±10% of reading ±10% of V p-p

Input Specifications

Input-A and Input-B (PM 6665 only)

Frequency Range
DC-Coupled: DC to 120 MHz, typ. to 160 MHz
AC-Coupled: 20 Hz to 120 MHz, typ. to 160 MHz
Minimum Pulse Duration: 4 ns
Coupling: AC- or dc-coupled, switch selectable
Impedance: 1 MΩ//35 pF
Channel Input: Separate A and B, or common via A
Maximum Voltage Without Damage: 350V (dc + ac peak) between 0 Hz and 440 Hz, falling to 8V rms at 1 MHz.

Sensitivity, DC-Coupled
Sine: 20 mV rms, 0 Hz to 100 MHz; 30 mV rms, 100 MHz to 120 MHz
Pulse: 60 mV p-p, 0 Hz to 100 MHz; 90 mV p-p, 100 MHz to 120 MHz; sensitivity decreases to 60 mV rms at 160 MHz typically

Sensitivity, AC-Coupled
Sine: 20 mV rms to 200 mV rms, 20 Hz to 100 MHz; 30 mV rms to 300 mV rms, 100 MHz to 120 MHz, continuously variable; sensitivity decreases to 60 mV rms at 160 MHz typically
Filter: Switchable 50 kHz low pass noise filter with approx 40 dB suppression at 1 MHz
Attenuation: x1 or x10
Trigger Slopes: Positive or negative, switch selectable

Trigger Level Range
DC-Coupled: +5V to -5V (attenuator x1); -50V to +50V (attenuator x10); adjustable by potentiometer
AC-Coupled: 0V fixed
Trigger Indicators: Indication on LCD display when triggering on inputs A or B occurs

Input-A and Input-B (PM 6666 only)

Frequency Range
DC-Coupled: DC to 120 MHz, typ. to 160 MHz
AC-Coupled: 20 Hz to 120 MHz, typ. to 160 MHz
Minimum Pulse Duration: 4 ns
Coupling: AC or dc
Impedance: 1 MΩ//35 pF
Channel Input: Separate A and B, or common via A
Maximum Voltage Without Damage: 350V (dc + ac peak) between 0 Hz and 440 Hz, falling to 8V rms at 1 MHz

Sensitivity, DC-Coupled
Sine: 20 mV rms, 0 Hz to 30 MHz; 40 mV rms, 30 MHz to 120 MHz
Pulse: 60 mV p-p, 0 Hz to 30 MHz; 110 mV p-p, 30 Hz to 120 MHz; sensitivity decreases to 60 mV rms at 160 MHz typically

Sensitivity, AC-Coupled
Sensitivity is selectable in 6 steps: 20 mV, 50 mV, 100 mV, 200 mV, 500 mV and 1V rms (sine) nominal
Maximum Sensitivity: 20 mV rms, 20 Hz to 30 MHz; 40 mV rms, 30 MHz to 120 MHz; sensitivity decreases to 60 mV rms at 160 MHz typically
Attenuation: x1 or x10, switch selectable or AUTO
Trigger Slopes: Positive or negative

Trigger Level Range
DC-Coupled: -51V to +51V, adjustable via up/down control
AC-Coupled: 0V fixed or AUTO level
Trigger Level Resolution: 20 mV, signals within ±5V; 200 mV, signals outside ±5V
Trigger Level Setting Accuracy: ±10 mV ±1% of setting
AUTO Trigger Level: Trigger Level on input A (and B when required) is automatically set to 50% of input signal amplitude.
Frequency range: 100 Hz to 120 MHz
Trigger Indicators: Tri-state LED indicators

Input C (Option PM 9608B)

Frequency Range: 70 MHz to 1.3 GHz
Coupling: AC
Operating Input Voltage Range: 10 mV rms to 12V rms, 70 MHz to 900 MHz; 15 mV rms to 12V rms, 900 MHz to 1100 MHz; 40 mV rms to 12V rms, 1100 MHz to 1300 MHz
AM Tolerance: 94% at max 100 kHz modulation frequency; minimum signal must exceed minimum operating input voltage requirement
Input Impedance: 50Ω nominal, VSWR <2:1
Max Voltage Without Damage: 12V rms, overload protection with pin diodes

External Reference Input

Input Frequency: 10 MHz ±0.1 MHz
Coupling: AC
Sensitivity: 500 mV rms
Input Impedance: Approx 300Ω at 10 MHz
Maximum Input Voltage: 15V rms

Auxiliary Functions

RESET

The RESET button has three functions:
RESET: Starts a new measurement. The settings are not changed.
LOCAL: Makes the counter go to LOCAL operation, when in remote operation (unless Local Lock-Out is programmed).
START/STOP: Opens/closes the gate in TOTALIZE A, manual mode.

Measuring Time

A measuring time of 0.2s, 1s, 10s or SINGLE can be selected

Display Hold

The current measuring result is frozen on the display. A new measurement starts when the RESET button is pressed.

Definitions

LSD Displayed

LSD = unit value of the least significant digit displayed. All calculated LSDs (see Measuring Functions section) should be rounded to the nearest decade (e.g., 0.3 Hz is rounded to 0.1 Hz and 5 Hz to 10 Hz) and cannot exceed the 9th digit.

Resolution

Resolution = smallest increment between two measuring results on the display, due to the ±1 count error.
Freq A, Freq C, Period A: Resolution can be 1 LSD or 2 LSD if:

$$\frac{\text{LSD x measuring time}}{\text{FREQ or PERIOD}} < 10^{-7}$$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).
Ratio A/B: Resolution can be 1 LSD or 2 LSD. If:

$$\frac{\text{LSD x measuring time}}{\text{RATIO}} < \frac{10}{\text{FREQ A}}$$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).
SINGLE Period A and SINGLE Ratio A/B: Resolution equals 1 LSD unit
Time A-B: Resolution (95% confidence level) equals 1 LSD unit or 100 ns/$\sqrt{N}$, whichever is greater

Inaccuracy

Inaccuracy, i.e., the relative error, depends on the following factors:

$$\pm \frac{\text{Resolution}}{\text{FREQ, PERIOD RATIO or TIME}}$$

± relative trigger error
± relative time base error
± relative systematic error

Relative Trigger Error

Freq A, Period A:

$$\pm \frac{\text{noise voltage A (V p-p)}}{\text{signal slope A (V/s) x meas time}}$$

Ratio A/B:

$$\pm \frac{\text{noise voltage B (V p-p)}}{\text{signal slope B (V/s) x meas. time}}$$

PM 6665 & PM 6666

Totalize A, Gated or Start/Stop by B:

$$\pm \frac{\text{noise voltage B (V p-p)}}{\text{signal slope B (V/s)} \times \text{gate time B}}$$

Time A-B:

$$\pm \frac{\text{noise voltage A (V p-p)}}{\text{signal slope A (V/s)} \times \text{TIME} \times \sqrt{N}} \pm \frac{\text{noise voltage B (V p-p)}}{\text{signal slope B (V/s)} \times \text{TIME} \times \sqrt{N}}$$

Relative Time Base Error:

$$\pm \frac{\text{deviation from 10 MHz}}{\text{10 MHz}}$$

Relative Time A-B Systematic Error: Inaccuracy caused by timing difference between A and B channels <±4 ns/TIME

General Specifications

Power Requirements

Line Voltage: 115V or 230V rms ±15%; 46 Hz to 440 Hz; <22 VA (PM 6665); resp <24 VA (PM 6666) including all options
Safety: In accordance with IEC 348 Class I and CSA 556B
Line Interference: Below VDE 0871 B and MIL STD 461
Battery Unit: See PM 9605 option

Oscillator Version	Standard	MTCXO
Stability Against		
Aging Per Month Per Year	 $<5 \times 10^{-7}$ $<5 \times 10^{-6}$	 $<1 \times 10^{-7}$ $<5 \times 10^{-7}$
Temperature Changes 0°C to 50°C	$<1 \times 10^{-5}$	$<2 \times 10^{-7}$
Line Voltage Changes 10%	$<1 \times 10^{-8}$	$<1 \times 10^{-9}$

Display

Readout: 9-digit LCD with unit and cursor indication
GATE Indicator: Indicates that the counter is measuring
REMOTE Indicator: Indicates when the counter is remotely controlled via an installed GPIB/IEEE-488 interface (PM 9604)

Environmental Data

Temperature
Operating: 0°C to +50°
Storage: -40°C to +70°

Altitude
Operating: 5000m (53.3 kN/m^2)
Storage: 15,000m (15.2 kN/m^2)

Humidity
Operating: 10% to 90% RH, no condensation
Storage: 5% to 95% RH

Mechanical Data

Size: 186 mm W x 88 mm H x 270 mm L (7.3 in W x 3.5 in H x 10.6 in L)
Weight: 2.1 kg (4.6 lb)

Optional Accessories

GPIB/IEEE-488 Interface, PM 9604

Mounting: Inside counter cabinet
Interface Functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E2

Max Data Output Rate
Normal Mode: Approx 5 readings/s
High-Speed Dump: Approx 100 readings/s. The highest output rate is obtained at SINGLE measuring time.
High-Speed Dump: The contents of the counting registers are transferred to the controller, without being processed by the counter. The processing must be done in the controller instead.

Output Time for Measuring Data
Normal Mode: Approx 9 ms (20 bytes)
High-Speed Mode: Approx 4 ms (15 bytes)
Response Time for Addressing: Approx 600 µs
Response Time for Trigger Command (GET): Approx 10 ms
Typical Read Time for Programming Data: Approx 1 ms/byte

Battery Unit PM 9605

The PM 9605 is a rechargeable battery unit for mounting inside the counter. The unit contains a standard 6V sealed lead-acid battery and an automatic battery charger.
Battery Capacity (20°C): Approx 15 Wh
Operating Time When Battery Powered: Approx 2 hours (PM 6666) or 2.5 hours (PM 6665) of continuous operation
Recharging Time: 5 hours to approx 75% of full capacity
Battery Protection: Overcharge protection and deep discharge (auto shut-off) protection

Temperature
Operating: 0°C to +40°C
Storage: -40°C to +50°C
Weight: 0.8 kg (1.8 lb)

Carrying Case PM 9609

The PM 9609 is a leather-like carrying case, for protection of the counter during transportation.

Ordering Information

Models

PM 6665 Timer/Counter
PM 6666 Timer/Counter

Included with the Instrument
One-year product warranty, line cord, operator manual, and Certificate of Calibration Practices.

Optional Configurations
When ordering, select basic "PM" Model desired from above, plus construct a 3-digit/suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface.

Input Frequency Option
/0-- Standard 160 MHz
/4-- 1.3 GHz (PM 9608B/00)

Reference Oscillator Option
/-1- Standard
/-3- MTCXO (PM 9607/00)

Interface Option
/--1 Standard line voltage, non GPIB/IEEE-488
/--3 Battery (PM 9605/00)
/--6 GPIB/IEEE-488 (PM 9604/00)

Example, Ordering Configurating
To order the PM 6666 with standard 160 MHz input, MTCXO Oscillator, and standard interface, select:

		Model
Configuration		PM 6666
Option Suffix -	Input	/0--
	Oscillator	/-3-
	Interface	/--1
Yields Complete Model Number		PM 6666/031

Options and Accessories
PM 2255/001 Instrument Driver Software
PM 9581/01 50Ω Termination 3W
PM 9585/01 50Ω Termination 1W
PM 9604/00* GPIB Interface
PM 9605/00* Battery Unit
HM 9606/00 Rack Kit for PM 6665/6 and 8840A/42A, PM 2525/34/35 DMMs
HM 9606/01 Rack Kit for PM 6665/6
PM 9607/00 MTCXO Time Base
PM 9608B/00 1.3 GHz HF-Input
PM 9609 Carrying Case
PM 9665B/01 50 kHz Low-Pass Filter BNC-BNC (for PM 6666)

All options can be field installed by the user.

**The GPIB interface PM 9604 and the battery unit PM 9605 cannot be installed together in a PM 6665/66 counter.*

Manuals
PM 6665 Operator*
PM 6666 Operator*
PM 6665/66/69 Pocket Guide
PM 6665/66 Service

**No charge with purchase of unit*

Customer Support Services

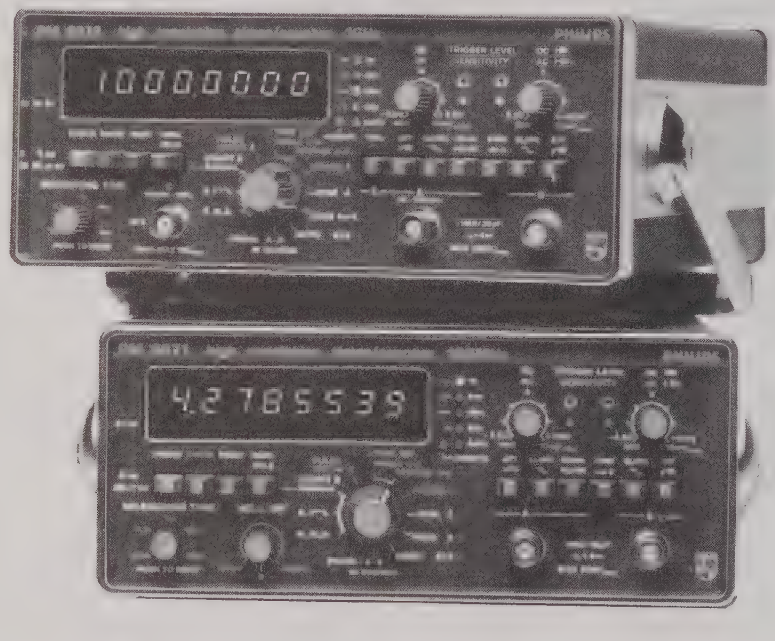
Also see Section 20.

Factory Warranty
One-year product warranty.

AVAILABLE THROUGH DISTRIBUTORS

PM 6671 & PM 6672

GPIB
IEEE-488



PM 6672
PM 6671

PM 6671 & PM 6672 Reciprocal Timer/Counters

- High resolution reciprocal frequency measurements (120 MHz to 1 GHz)
- Superior time resolution to 10 ps (using time interval averaging)
- Advanced, accurate trigger facilities
- Multiple measuring modes including burst frequency average, pulse width, phase, RPM, and ratio
- High stability crystal oscillators, up to 5 x 10^{-10}/24h
- Excellent 10 mV sensitivity
- GPIB/IEEE-488 option

These microcomputer-based timer/counters satisfy a wide range of frequency and time measurement requirements. Their general purpose versatility, wide frequency range, high accuracy crystal oscillators and powerful measuring features makes them ideal for research and development applications.

A choice of bus interfaces, including the GPIB/IEEE-488* bus puts this capability at the user's disposal for production and quality assurance testing. In addition, the optional battery unit extends the use of the instruments to field service applications.

Choice of Time Base Oscillator

The time base crystal oscillator determines the accuracy limit of the counters.

Note that even the most stable version (5 x 10^{-10}/24h) can be operated from internal batteries. This unique feature is achieved by specially developed oven-stabilized crystal oscillators with extremely low power consumption. Thus laboratory accuracy is now available for field applications – without long warm-up periods after changing location.

By means of external reference input, the user's own frequency standard can also be used, when available.

High Time Resolution

For time interval measurements, these instruments feature high measuring resolution. By using the time interval averaging technique, these timer/counters greatly improve both the measuring accuracy and the resolution.

Compared to single time interval measurements, the basic 100 ns resolution is improved by a factor of $\sqrt{N}$, where N is the number of time intervals being averaged.

With the PM 6671/72, N can be more than 10^8. The resolution becomes:

$$\frac{100\text{ ns}}{\sqrt{10^8}} = 10\text{ ps}$$

High Trigger Accuracy

Ultimately, no counter is better than its front-end circuitry. Therefore the PM 6670 series employs the best front-end circuit design available.

These timer/counters feature special input signal conditioning configurations, which are optimized for both frequency and time interval measurements, e.g. either adjustable trigger levels for time interval measurements or adjustable sensitivity and noise immunity for frequency measurements.

Automatic Triggering on RF Signals

The 1 GHz model PM 6672 has a special RF input with front-end circuits that feature advanced RF techniques, including PIN-diode attenuators that bring a number of user benefits:

- Automatic triggering
- Excellent overload protection; 12V rms
- High AM tolerance: up to 98%
- Wide dynamic range: 15 mV rms to 12V rms

Trigger Hold-Off and Arming

The PM 6671 and PM 6672 give full control over the start conditions of a measurement. With an external gate signal, one can prevent the timer/counter from triggering on the first input signal.

Another useful feature, found on the PM 6671 is trigger hold-off, which avoids false stop triggering on spurious or unwanted signals. A typical example is the pulses from relay contact bounce.

Specifications

Measuring Functions

Frequency A
Range: 0.1 Hz to 120 MHz. At least 7 digits displayed per second of measuring time.

Frequency C (PM 6672 only)
Frequency Range: 70 MHz to 1 GHz. At least 7 digits displayed per second of measuring time.

Period A Average
Range: 100 ns to 100s. At least 7 digits displayed per second of measuring time.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 6671 & PM 6672

Time Interval A to B, Pulse Width A; Single
Range: 100 ns to 10^8s, resolution 100 ns

Time Interval A to B Average
Range: 0 ns to 100s, resolution (100 ns)/$\sqrt{N}$

Count A
Range: 1 to 10^{17}
Mode: Manual or externally controlled via B

Phase A-B
Range: 0.1° to 360° x (1-300 ns x FREQ)
Frequency Range: 0.03 Hz to 1.6 MHz

Ratio A/B
Range: 0 MHz to 10 MHz/0 MHz to 10 MHz

RPM
Range: 0.6 to 10^8RPM, (1 pulse per revolution)
Frequency Range: DC, 100 Hz to 120 MHz

Input and Output Specifications

Input A and B

Frequency Range
DC-Coupled: 0 MHz to 120 MHz
AC-Coupled: 50 Hz to 120 MHz
Rise Time: Approx. 4 ns

Sensitivity
DC-Coupled: 10 mV rms sine wave or 30 mV p-p (0 MHz to 75 MHz), 20 mV rms sine wave or 60 mV p-p (75 to 120 MHz)
AC-Coupled: 10 mV rms to 100 mV rms sine wave (0 MHz to 75 MHz), 20 mV rms to 100 mV rms sine wave (75 to 120 MHz)
Attention: x1, x10 fixed
For frequency related measurements, the fixed attenuator can be used in combination with the continuously variable attenuator x1 to x10 (ac coupled position)

Noise Immunity/Hysteresis Band
DC-Coupled: Approx. 20 mV p-p/200 mV p-p
AC-Coupled: Approx. 20 mV p-p to 2V p-p

Dynamic Input Voltage Range
DC-Coupled: 30V p-p to 5V p-p/300 mV p-p to 50V p-p
AC-Coupled: 10 mV rms to 2V rms/100 mV rms to 20V rms

Trigger Level
DC-Coupled: -2.5V to +2.5V/-25V to +25V
AC-Coupled: Fixed 0V; level control acts as continuously variable attenuator, which is more suitable for frequency related measurements
Trigger Level Output: Set trigger voltages -2.5V to +2.5V, available on 1 mm jacks at the front for monitoring of set trigger level
Coupling: DC/AC
Impedance: Approx. 1 MΩ/35 pF, independent of sep/com switch position
Channel Input: Separate A and B or common A
Noise Filter: Switchable 50 kHz low-pass filter in channel A. Noise suppression approx. 40 dB at 1 MHz.

Rear Panel Inputs and Outputs

Input/Output D: 50 kHz to 10 MHz for external reference frequency or ration input, or 10 MHz internal reference frequency output
Input E: External arming, frequency average or external arming, frequency average or external reset input
Gate Monitor Output: Gate open/closed and hold-off time output signal

GPIB/IEEE-488 Bus

All front panel accessible functions except input trigger functions are programmable
Data Output Rate: 10 to 20 readings/s

General Specifications

Measuring Time: 10 ms to 96s
Display Hold: Freezes measuring result
Trigger Hold-Off Range: 200 μs to 200 ms (PM 6671 only)
Check: Applies 10 MHz time base frequency to the measuring logic
Reset: Manual via push-button or electrical via input E
Power On/Stand By: In "ST BY" position, power is available to maintain an ovenized crystal oscillator
Display: 8 digits LED display plus unit indicators
Operating Temperature: -5°C to 50°C
Power Requirements: 115/230V ±15%, 45 Hz to 440 Hz; 25 VA. The timer/counters can also be powered from an optional battery pack or an external DC voltage: 11.8V to 28V.
Size: 210 mm W x 89 mm H x 280 mm L (8.25 in W x 3.8 in H x 11 in L)
Weight: Net, 2.5 kg. (5.5 lb); shipping, 3.6 kg

Ordering Information

Models

PM 6671 120 MHz Timer/Counter, 100 ns single shot resolution, standard oscillator 5x10^{-7} month
PM 6672 As PM 6671 but with extended facilities and frequency range to 1GHz

Included with Instrument

One-year product warranty, line cord, operator manual, and Certificate of Calibration Practices.

Optional Configurations

When ordering, select basic "PM" Model desired from above, plus construct a 3-digit suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface.

Input Frequency Option

/0-- 120 MHz for PM 6671
/4-- 1 GHz for PM 6672

Reference Oscillator Option

/-1- Standard
/-2- TCXO (PM 9678B/01)
/-4- Very High Stability Crystal Oscillator (PM 9690/01)
/-5- Ultra High Stability Crystal Oscillator (PM 9691/01)
/-8- Externally Referenced Frequency Multiplier (PM 9697/00), with Standard Oscillator only

Interface Option

/--1 Standard, non GPIB/IEEE-488
/--3 Battery (PM 9693/00) for all
/--5 Analog Output (PM 9695/00) for all
/--6 GPIB IEEE-488 (PM 9696B/00) for all

Example, Ordering Configuration

To order the PM 6671 with standard 120 MHz input, temperature compensated oscillator, and no interface, select:

		Model
Configuration		PM 6671
Option Suffix -	Input	/0--
	Oscillator	/-2-
	Interface	/--1
Yields Complete Model Number		PM 6671/021

Options and Accessories

PM 9581/01 50Ω Feedthrough Termination 3W
PM 9585/01 50Ω Feedthrough Termination 1W
PM 9669/01 19-in Rack Mount Adapter to fit one instrument
PM 9669/02 19-in Rack Mount Adapter to fit two instruments
PM 9672/70 Carrying Case
PM 9678B/01 Temp Compensated Oscillator
PM 9690/01 Very High Stability Oscillator
PM 9691/01 Ultra High Stability Oscillator
PM 9693/00 Battery Unit
PM 9695/00 Analog Recorder Output
PM 9696B/00 IEEE-488 Bus Interface
PM 9697/00 External Reference Frequency Multiplier

The PM 9697 multiplier can only be installed simultaneously with the /01 oscillator. For installation in other versions the oscillator has to be removed first.

Manuals

PM 6670-72 Operator*
PM 6670-72 Service

**No charge with purchase of unit*

Customer Support Services

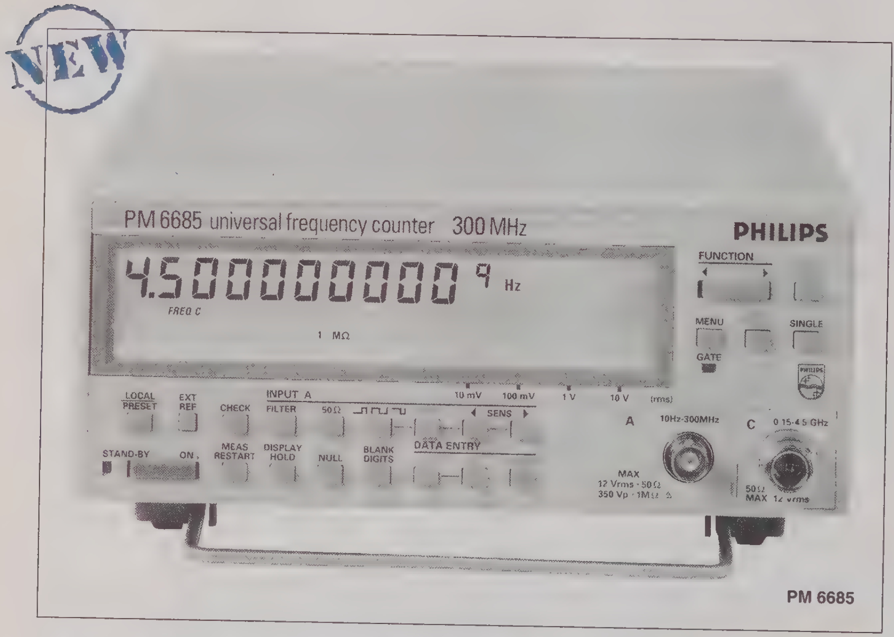
Also see Section 20.

Factory Warranty

One-year product warranty.

PM 6685

SCPI
GPIB
IEEE-488



PM 6685

PM 6685 High Performance Universal Frequency Counter

- Displays 10 digits in a second
- Smart AUTO function eliminates the guesswork, provides error-free triggering
- High stability time bases up to 5 x 10^{-10}/24 hr oven or 5 x 10^{-11}/month rubidium
- 300 MHz input range with options of 1.3 GHz, 2.7 GHz, or 4.5 GHz
- Automatic burst synchronization
- Dual displays for frequency/time and signal level
- Duty factor and pulse width measurements
- Connect-and-go convenience for the bench or field

Counts Ten in Under a Second

The PM 6685 frequency counter from Fluke brings high performance, calibration-lab accuracy to the field. With 10 digits per second resolution, it delivers high accuracy measurements instantly. The high resolution is matched by high-stability time bases up to 5 x 10^{-10}/24 hr (oven) or 5 x 10^{-11}/month (rubidium).

Its high accuracy is also matched by high speed display updates. The PM 6685 can perform 9 digit measurements 4 times a second so you can make calibration adjustments in "real time".

Just Connect and Go

The PM 6685 has the brains to eliminate a lot of the button pushing and knob turning. Just plug it in and it automatically sets the proper trigger level and adjusts the input sensitivity for excellent noise immunity, and error-free triggering. The easy-to-read analog bar-graph gives you instant feedback on whether the signal level is adequate. And a built-in NULL function gives you the power to make relative measurements in reference to the value on the display, or to a manually entered numerical value. It's great for tuning and adjusting.

Special Functions to Handle a Wide Range of Jobs

Need to measure the frequency of non-continuous waves? The PM 6685 has your number. Measure burst frequencies or the PRF (pulse repetition frequency) or burst signals without an external synchronization signal.

Need to look at digital control signals? Just push a button to measure pulse width or duty factor. The PM 6685 automatically changes the sensitivity for maximum accuracy.

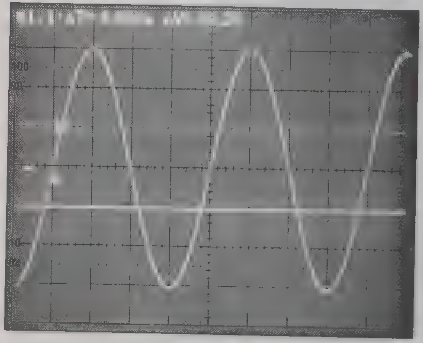
A variety of field-installable options give you the power to adapt the PM 6685 to your applications and budget as you go. The counter comes with a standard frequency input range of up to 300 MHz and optional 1.3 GHz, 2.7 GHz, or 4.5 GHz inputs. You can choose from 5 different internal time bases, a standard crystal oscillator, TCXO, and two ovenized high-stability Crystal oscillator time bases and a rubidium time base. And you can add a battery pack, carrying case, and handle kit for safe storage and transport to the field.

With an optional GPIB interface, the PM 6685 complies with the latest GPIB/IEEE-488.2* bus standard and the international SCPI command set (Standard Commands for Programmable Instruments).

Automatic Trigger Level Setting

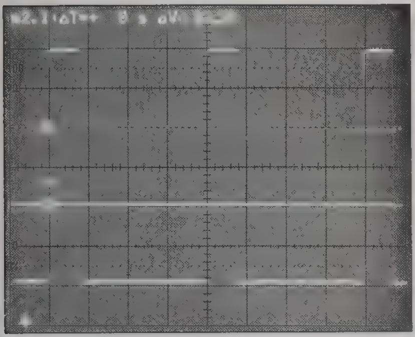
The PM 6685 can automatically set AUTO-trigger/AUTO-sensitivity functions for any input signals above 50 Hz. Whether the input signal is symmetrical or not, the PM 6685 sets the trigger level in the middle of the input signal. To cope with noisy signals, it automatically sets an input sensitivity equal to one third of the input signal amplitude. This provides optimum noise immunity without a lot of frustrating knob turning.

The PM 6685 also automatically triggers at 50% of amplitude (with maximum sensitivity and minimum hysteresis) in Pulse Width and Duty Cycle measurements, so you can change from frequency to pulse-width measurements without manually adjusting input sensitivity.



The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

PM 6685



The unique AUTO-trigger sets the width of the trigger hysteresis (noise immunity) band to a third of the input amplitude. Simultaneously it centers the hysteresis band just at the middle of the input signal. Regardless of the amplitude and waveform duty cycle, error-free triggering with a high noise immunity is thereby guaranteed.

Analog Signal Verification

No longer do you have to carry along a separate instrument just to verify the strength of the input signal. The built-in analog bar-graph (3 dB/segment) signal level monitor automatically verifies adequate signal level. If you lose the signal during the measurement a "No signal" message is immediately displayed so you won't waste time with an irrelevant measurement.

Prevents Overload

The smart PM 6685 always checks input signal levels before it allows you to switch from 1MΩ to 50Ω input terminator. If the signal level is too high, the input remains in the 1MΩ setting and an "OVERLOAD" message appears on the display. That keeps you from damaging the system by accidentally switching to the lower impedance input when you're measuring a high-voltage signal.

Read Only the Digits You Need

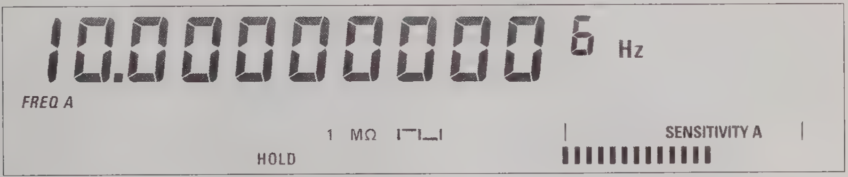
When you don't need the full 10 digits the "Digit Blanking" function lets you eliminate irrelevant digits one by one. No more having to hunt down the black tape to block out the extra digits. This is especially useful when measuring unstable signal sources.

Measures Short Bursts

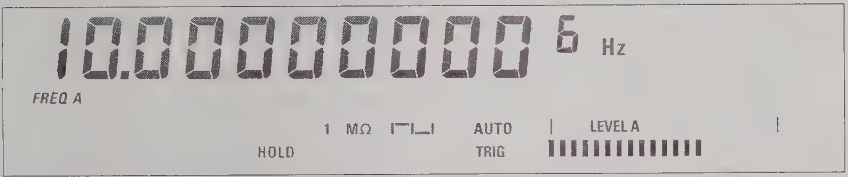
The PM 6685 measuring time can be set from 800 ns to 400s to handle virtually all applications. For even shorter measuring periods, you can select the SINGLE mode to measure as few as one or two input cycles.

Internal Burst Synchronization

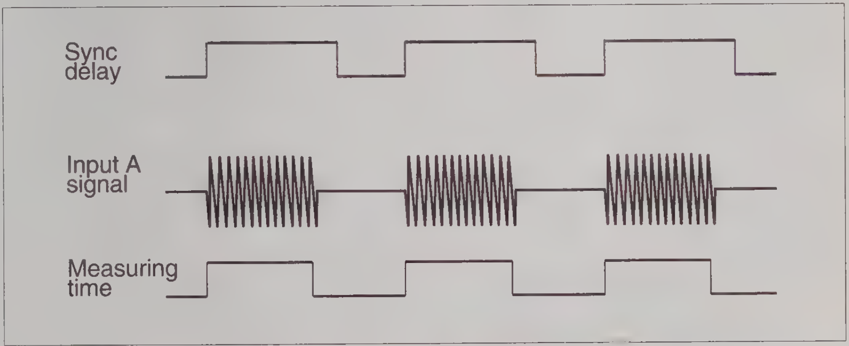
The PM 6685 automatically synchronizes with any burst frequency on the input using a special "single-line" burst frequency mode. You simply enter a "Sync Delay" slightly longer than the burst and the counter automatically synchronizes for correct triggering. You can use this same "Sync Delay" to measure the PRF.



In manual-trigger mode, a bar-graph shows the set sensitivity (3 dB/bar).



In AUTO-trigger mode, a bar-graph shows the input signal amplitude. This input level monitor is a convenient feature to monitor that an adequate signal level is present for error-free triggering.



PRF and burst frequency measurements can easily be made without external gating signals.

External Arming Delay for Pinpoint Precision

If an external arming signal is available, the PM 6685 lets you do even more. A unique Arming Delay function lets you delay the arming point anywhere from 200 ns to 1.6s in 100 ns increments. Just connect your sync signal to the arming input and specify the delay time. This can help improve accuracy by eliminating measurements of unstable portions of a signal.

Set Your Own References

The PM 6685's unique built-in NULL function allows you to reference measurements to any value on the display just by pushing a button. You can also manually enter your own reference point. This is especially useful in receiver testing because you can measure the IF-offset frequency of the local oscillator and display it as received frequency.

Specifications

Technical Specifications

Measuring Functions

Refer to table 1 for measurement uncertainty information.

Frequency A, C

Range

Input A: 10 Hz to 300 MHz
Input C: 70 MHz to 1.3 GHz (PM 9621)
100 MHz to 2.7 GHz (PM 9624)
150 MHz to 4.5 GHz (PM 9625)
Resolution: 10 digits/s measurement time

Burst Frequency A

Frequency Range: 100 Hz to 160 MHz
PRF Range: 1 Hz to 100 kHz
Pulse Width Range: 1 µs to 50 ms, min. 3 periods of this signal

Period A

Range: 6 ns to 100 ms
Resolution: 10 digits/s measurement time

PM 6685

Ratio A/E, C/A

Range: 10^{-7} to 10^{10}
Frequency Range:
Input A: 10 Hz to 160 MHz
Input E: 10 Hz to 50 MHz
Input C: 70 MHz to 1.3 GHz (PM 9621)
100 MHz to 2.7 GHz (PM 9624)
150 MHz to 4.5 GHz (PM 9625)

Pulse Width A

Range: 3 ns to 10 ms
Frequency Range: 50 Hz to 160 MHz
Voltage Range: 100 mV p-p to 70V p-p

Duty Factor A

Range: 0 to 1
Frequency Range: 50 Hz to 160 MHz
Voltage Range: 100 mV p-p to 70V p-p

Totalize A

Event counting on input A with manual start and stop
Range: 0 to 10^{17}
Frequency Range: 0 to 160 MHz

Input and Output Specifications

Input A

Frequency Range: 10 Hz to 300 MHz
Coupling: AC
Impedance: 1 MΩ//25 pF or 50Ω, VSWR < 2:1
Sensitivity:
Sinewave: 10 mV rms, 10 Hz to 50 MHz
15 mV rms, 50 MHz to 100 MHz
20 mV rms, 100 MHz to 150 MHz
30 mV rms, 150 MHz to 200 MHz
50 mV rms, 200 MHz to 300 MHz
Pulse: 50 mV p-p, 3 ns minimum pulse width
Dynamic Range: 30 mV p-p to 70V p-p
Manual Trigger:
Sensitivity Range: 10 mV rms to 10V rms, variable in 3 dB steps, indicated on a bar graph
Trigger Level: Selectable for optimum triggering on waveforms with duty factors <0.25, 0.25 to 0.75 and >0.75
Trigger Slope: Positive or negative
Auto Trigger: Automatic setting of input signal conditioning circuits for optimum triggering on different amplitudes and waveforms
Frequency: Minimum 50 Hz
Sensitivity Range: 10 mV rms to 25V rms
Signal Monitor: A bar graph displays actual input signal level in 3 dB steps, 10mV rms to 10V rms
Low Pass Filter: 100 kHz nominal 3 dB point. Minimum 40 dB attenuation at 1 MHz.

Damage Level
1 MΩ: 350V (dc + ac peak) at dc to 440 Hz, falling to 12V rms at 1 MHz and above
50Ω: 12V rms

Input C (Option PM 9621)

Frequency Range: 70 MHz to 1.3 GHz
Prescaler Factor: 256
Operating Input Voltage Range:
70 to 900 MHz: 10 mV rms to 12V rms
900 to 1100 MHz: 15 mV rms to 12V rms
1100 to 1300 MHz: 40 mV rms to 12V rms
Amplitude Modulation:
dc to 0.1 MHz: Up to 94% depth
0.1 to 6 MHz: Up to 85% depth
Minimum signal must exceed minimum operating input voltage
Impedance: 50Ω nominal, ac coupled, VSWR <2:1
Damage Level: 12V rms, pin-diode protected
Connector: BNC

Input C (Option PM 9624)

Frequency Range: 100 MHz to 2.7 GHz
Prescaler Factor: 16
Operating Input Voltage Range:
100 MHz to 300 MHz 20 mV rms to 12V rms
0.3 GHz to 2.5 GHz 10 mV rms to 12V rms
2.5 GHz to 2.7 GHz 20 mV rms to 12V rms
Amplitude Modulation: As PM 9621
Impedance: 50Ω nominal, ac coupled, VSWR <2,5:1
Damage Level: 12V rms, pin-diode protected
Connector: Type N Female

Input C (Option PM 9625)

Frequency Range: 150 MHz to 4.5 GHz
Prescaler Factor: 32
Operating Input Voltage Range:
150 to 300 MHz 20 mV rms to 1V rms
(-21 to +13 dBm)
0.3 to 2.5 GHz 10 mV rms to 1V rms
(-27 to +13 dBm)
2.5 to 3.7 GHz 15 mV rms to 1V rms
(-23.5 to +13 dBm)
3.7 to 4.5 GHz 25 mV rms to 1V rms
(-19 to +13 dBm)
Amplitude Modulation: As PM 9621
Impedance: 50Ω nominal, ac coupled, VSWR 2,5:1 typical
Damage Level: 12V rms (+34 dBm), pin-diode protected
Connector: Type N Female

External Reference Input D

The use of external reference is indicated on the display
Input Frequency: 10 MHz standard. 1 MHz and 5 MHz with optional Reference Frequency Multiplier (PM 9697).
Voltage Range: 500 mV rms to 10V rms
Impedance: Approx 1 kΩ (ac coupled)

Input E

Used in Ratio A/E and external arming/gating modes
Frequency Range: DC to 50 MHz
Pulse Width: 10 ns minimum
Slew Rate: 2V/µs minimum
Trigger Level: TTL level, 1.4V nominal
Trigger Slope: Positive or negative
Impedance: Approx 2 kΩ (dc coupled)
Damage Level: ±25V peak

Reference Output G

Frequency: 10 MHz, sine wave
Output Level: >0.5V rms into 50Ω load, >0.7V rms into high impedance load
Coupling: AC

Auxiliary Functions

External Arming/External Gate

External signal on input E can be used to inhibit start and/or stop triggering. Stop arming is not applicable to Pulse Width and Duty Factor measuring modes.
Start Arming Delay: OFF or 200 ns to 1.6s in 100 ns steps

Nulling/Frequency Offset

Nulling enable measurements to be displayed relative to a previously measured value or any frequency offset value entered via front panel keys

Other Functions

Measuring Time: Single cycle, 0.8, 1.6, 3.2, 6.4, 12.8 µs and 50 µs to 20s, (up to 400s, depending on measuring function and input signal frequency)
Local/Preset: Go to local function in remote mode, or preset counter to default setting in local mode
Restart: Starts a new measurement
Display Hold: Freezes measuring result. Start and stop of the totalization in TOT A MAN.
Check: Applies 10 MHz to the measuring logic
Display: LCD with high-luminance backlight
Number of Digits: 10 digits plus exponent
Blanking: Least significant digits can be blanked
Bar graph: Displays input signal level or sensitivity setting in 3 dB steps from 10mV rms to 10V rms
Auxiliary Menu: The following functions are available from the AUX MENU and via the GPIB interface
Save/Recall: 19 complete instrument settings. 10 settings can be user protected
GPIB-Address: Read and temporarily change via front panel keys. (Set new address on rear panel switch.)
Burst Frequency: A or C (PM 9625) input, set synchronization delay time
PRF: A or C (PM 9625) input, set synchronization delay time
Trigger Slope: Positive or negative slope
Arming Start: Positive or negative slope, set start arming delay time
Arming Stop: Positive or negative slope
Null: Read and change stored offset frequency
Display Overflow: Display of the 11th and 12th digits
Test: Select selftests
Program Version: Display instrument and GPIB program versions
Time Out: OFF or 100 ms to 25.5s in 100 ms steps
Analog Output: Select digits and scaling factor
Display Backlight: On/off

Measurement Uncertainties

Measuring functions	Random Uncertainty rms	Systematic Uncertainty	LSD Displayed
Frequency Period	$\pm \frac{\sqrt{(350\text{ ps})^2 + (\text{Trigger Error})^2}}{\text{Measuring Time}}$ x Freg. or Per.	± Time Base Error x Freqeuncy or Period	$\frac{350\text{ ps} \times \sqrt{2}\ \text{Freq. or Period}}{\text{Measuring Time}}$
Ratio f_1/f_2	$\pm \frac{\sqrt{(\text{Prescaler factor})^2 + (f_1 \times \text{Trigger Error of } f_2)^2}}{f_2 \bullet \text{Measuring Time}}$		$\frac{\text{Prescaler Factor}}{f_2 \times \text{Measuring Time}}$
Phase (Auto Trigger)	$\pm \sqrt{(350\text{ ps})^2 + (\text{Trigger Error})^2}$	± Time Base Error x Pulse Width ± 0.5 x Transition Time ± 1.5 ns	100 ps
Duty Factor (Auto Trigger)	$\pm \sqrt{(350\text{ ps})^2 + (\text{Trigger Error})^2}$ x Frequency	± (0.5 x Transition Time + 1.5 ns) x Frequency	1×10^{-6}

Table 1. Measurement Uncertainties and LSD Displayed.

Random Uncertainty

Random uncertainty is due to quantization error, short-term Time Base stability, internal noise and input signal noise. The random uncertainty can be reduced by increasing the measurement time. **Trigger Error:** Internal noise and input signal noise, expressed as an rms Trigger Error.

$$\text{Trigger Error} = \frac{1.4 \times \sqrt{(e_{amp})^2 + (e_n)^2}}{\text{Signal slew rate (V/s) at trigger point}}$$

Where:

e_{amp} = rms input amplifier noise (250 µV rms typical)

e_n = rms noise of the input signal over a 300 MHz bandwidth

Systematic Uncertainty

See crystal oscillator specifications for aging and possible frequency deviation due to the oscillator's temperature dependency

LSD Displayed

Unit value of Least Significant Digit (LSD) displayed. After calculation, the LSD value is rounded to the nearest decade before display (for example >0.5 Hz will be 1 Hz and ≤0.5 Hz will be 0.1 Hz). LSD blanking is available to reduce displayed resolution. Measuring times >1s can give significance in > 10 digits. The 11th and 12th digits can be displayed using the display overflow function.

Battery Unit (Option PM 9623)

The PM 9623 is a rechargeable battery unit for mounting inside the counter.

Battery Type: Sealed lead-acid cells

Battery Capacity: At 25°C

Standby Mode: Typically 20 hours with Oven Time Base

Operating Mode: Typically 3 hours without options, 2.5 hours with Oven Time Base, and 2 hours with Oven Time Base and Input C

Recharge Time: Typically 8 hours in standby mode

Battery Protection: Overcharge and deep discharge protection

External DC: 12V to 24V via socket on rear panel (16V to 24V to charge internal battery)

Options

Time Base Options

Standard Stability against \ Model Options	/_1_ Standard	/_2_ PM 9678B TCXO	/_4_ PM 9690 Oven	/_5_ PM 9691 Oven	/_7_ Rubidium
Aging: /24h	N/A	N/A	$<1.5 \times 10^{-9}$*	$<5 \times 10^{-10}$*	$<2 \times 10^{-12}$
/month	$<5 \times 10^{-7}$	$<1 \times 10^{-7}$	$<3 \times 10^{-8}$	$<1 \times 10^{-8}$	$<5 \times 10^{-11}$**
/year	$<5 \times 10^{-6}$	$<5 \times 10^{-7}$	$<1.5 \times 10^{-7}$	$<7.5 \times 10^{-8}$	$<5 \times 10^{-10}$
Temperature 0 to 50°C ref. to + 23°C	$<1 \times 10^{-5}$	$<1 \times 10^{-6}$	$<3 \times 10^{-8}$	$<5 \times 10^{-9}$	$<3 \times 10^{-10}$
Line Voltage ± 10%	$<1 \times 10^{-8}$	$<1 \times 10^{-9}$	$<5 \times 10^{-10}$	$<5 \times 10^{-10}$	$<1 \times 10^{-11}$
Warm-up Time to Reach 10^{-7} of Final Value	N/A	N/A	<15 min	<15 min	<6 min. to reach 10^{-9}

**after 48 hours of continuous operation*

*** after 1 month of continuous operation*

Line Failure Protection: Counter automatically switches to internal battery or external dc when the line voltage falls below 90V ac

Temperature

Operating: 0°C to +40°C

Storage: -40°C to +50°C

Weight: 1.5 kg (3.3 lb)

GPIB (Option PM 9626/02)

Programmable Functions: All front panel and AUX MENU functions

Compatibility: IEEE 488.2-1987, SCPI 1991.0

Interface Functions: SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, E2

Maximum Measurement Rate to Internal Memory: 200 to 1600 readings/s, depending on measurement function and internal data format

Internal Memory Size: 764 to 2600 readings, depending on measurement function and internal data format

Maximum Bus Transfer Rate: 150 to 1000 readings/s, depending on internal data format and output data format

Data Output Format: ASCII, IEEE double precision floating point

Time Out: Off or 100 ms to 25.5s in 100 ms steps

Analog Output: 0 to 4.98V in 20 mV steps, derived from three consecutive digits selected from the measurement result

Output Impedance: 200Ω

General Specifications

Environmental Conditions

Temperature

Operating: 0°C to +50°C

Fan option PM 9628/02 is required when ambient temperature >45°C and oven oscillator PM 9690 or PM 9691 is installed

Storage: -40°C to +70°C

Humidity: 95% RH, 0°C to 30°C

Altitude

Operating: Up to 4600m (15000 ft)

Non-operating: Up to 12000m (40000 ft)

Vibration: 3G at 55 Hz per MIL-T-28800D, Class 3, Style D

Shock: Half-sine 40G per MIL-T-28800D, Class 3, Style D. Bench handling. Shipping container.

Reliability: MTBF 30 000 hours

Safety: IEC 1010 Class 1, CSA 22.2 No. 231

EMC: EN 55011, VDE 0871 Level B, FCC Part 15J Class A

Power Requirements

AC: 90 to 265V rms, 45 to 440 Hz, max 30W

DC (PM 9623): Internal battery or external 12 to 24V dc, max 2A

Mechanical Data

SizeWidth: 86 mm H x 210 mm W x 395 mm D (3.4 in H x 8.25 in W x 15.6 in D)

Weight: Net 3.2 kg (7 lb); shipping 5.5 kg (12 lb)

PM 6685

Ordering Information

Model

PM 6685 300 MHz Frequency Counter

Included with Instrument

One-year product warranty, line cord, operator manual, and Certificate of Calibration Practices.

Input Frequency Options

PM 6685/0-- Standard 300 MHz
PM 6685/4-- 1.3 GHz Input C (PM 9621)
PM 6685/6-- 2.7 GHz Input C (PM 9624)
PM 6685/7-- 4.5 GHz Input C (PM 9625)

Time Base Options

PM 6685/-1- Standard Time Base
PM 6685/-2- TCXO (PM 9678B)
PM 6685/-4- High Stability Oven Time Base (PM 9690)
PM 6685/-5- Very High Stability Oven Time Base (PM 9691)
PM 6685/-7- Rubidium Time Base*

** Product physical dimensions are larger with rubidium time base. The rubidium time base is not customer installable. Call for complete product specifications and availability.*

PM 6685/-8- Standard Time Base plus External Ref. Frequency Multiplier (1, 5 MHz) (PM 9697)

Battery Unit and GPIB Interface Options

PM 6685/--1 No Battery Unit or GPIB Interface
PM 6685/--3 Battery Unit (PM 9623)
PM 6685/--6 GPIB Interface (PM 9626/02)
PM 6685/--8 Battery Unit plus GPIB Interface

Example, Ordering Configuration

To order the 300 MHz version with the TCXO Time Base and GPIB interface, select:

		Model
Configuration		PM 6685
Option Suffix -	Input	/0--
	Oscillator	/-2-
	Interface	/--6
Yields Complete Model Number		PM 6685/026

Options and Accessories

PM 9621/00 1.3 GHz Input C
PM 9622/02 Rack Mount Kit
PM 9622/03 Side Handle Kit
PM 9623/00 Battery Unit
PM 9624/00 2.7 GHz Input C
PM 9625/00 4.5 GHz Input C
PM 9626/02 GPIB Interface
PM 9627 Carrying Case
PM 9628/02 Cooling Fan (>50°C ambient)
PM 9678B/01 TCXO Time Base
PM 9690/01 High Stability Oven Oscillator Time Base
PM 9691/01 Very High Stability Oven Oscillator Time Base
PM 9697/00* External Reference Multiplier (1, 5, 10 MHz)

When ordered together with the basic counter, options are factory installed. Options ordered separately can be customer retrofitted.

**PM 9697 External Reference Multiplier can be used only with the Standard Time Base.*

Manuals

PM 6685 Operator*
PM 6685 Program
PM 6685 Service

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty

One-year product warranty.

PM 6673, PM 6674, PM 6675, PM 6676 & PM 6677

GPIB IEEE-488

150000000
550000000
500368936

PM 6676
PM 6674
PM 6673

PM 6673-PM 6677 Universal Frequency Counters
High resolution (7 to 9 digits/s)
Wide frequency range to 2.3 GHz
Error-free triggering with wideband noise suppression
High stability crystal oscillators up to 5 x 10^{-10}/24 hours
High 10 mV sensitivity
Arming facility for complex signal measurements
Analog output on GPIB/IEEE-488 for bench or system
Battery option for portable use

These microprocessor-based universal frequency counters satisfy a wide range of frequency measurement requirements. Their high accuracy concept, wide frequency ranges and new powerful measuring features make these counters ideal for research and development of telecommunication, broadcast, TV, radio control and navigation equipment.

Lightweight, compact construction results from the dramatically reduced number of components – down to only a few state-of-the-art LSI circuits, including a counter-on-a-chip and a one-chip microcomputer. Philips' advanced R & D capability yields reduction in size and cost while still providing the ultimate in reliability and performance.

A choice of interfaces, including the GPIB/IEEE-488* bus, puts this capability at the user's disposal for production and quality assurance testing. In addition, the optional battery unit extends the use of instruments to field service applications.

High Resolution Computing Counting

By making a synchronized multiple-period measurement and computing the reciprocal value, the counters perform high resolution frequency measurements on all low frequency signals. The built-in microcomputer eliminates traditional ±1 input cycle errors and as a result gives at least seven digits resolution per second of measuring time. This avoids the need for long gate times, normally required to obtain a high resolution.

Above 10 MHz, the conventional counting method is automatically selected, to give improved resolution at the higher frequencies .

Error-Free Triggering

Ultimately, no counter is better than its front-end circuitry. Therefore the PM 6670 series employs the best front-end circuit concept available. The wideband, continuously variable input attenuator allows optimum matching of trigger sensitivity and noise immunity over a wide dynamic range from 20 mV p-p to 10V p-p. (See introduction of the counter section.)

To obtain full benefit from the high resolution reciprocal design, meaningless digits can be excluded by a switchable built-in noise-rejection filter for low frequency measurements. This filter even rejects high frequency noise or interference that is stronger than the input signal itself.

Automatic Triggering on RF Signals

The UHF counter models PM 6674, 6675, 6676 and 6677 have special RF inputs up to 550 MHz, 600 MHz, 1.5 GHz and 2.3 GHz respectively. Their front-end circuits feature advanced RF techniques, including automatic PIN-diode attenuators that bring a number of user benefits:

- Automatic triggering
- Excellent overload protection; 12V rms
- High AM tolerance: up to 94%
- Wide dynamic range: 10 mV rms to 12V rms

For high speed/high accuracy measurements, the 600 MHz model PM 6675 offers direct gating (non-prescaled) and a high 5 mV rms sensitivity.

RFI Suppression

Effective precautions have been taken to reduce radiation and susceptibility to radio frequency interference (RFI) to minimum levels. For example,all the counters are encased in sturdy metal cabinets, which provide excellent RFI shielding. Reduction of RFI radiation far below the most

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 6673, PM 6674, PM 6675, PM 6676 & PM 6677

stringent requirements, including MIL-STD 461 and VDE 0871 (B), contributes to the superior accuracy of these models.

Variable Measuring Time

Another microcomputer benefit is the continuously variable measuring time, which is no longer limited to decade steps. It is possible, for example, to select a measuring time of 2.4 seconds if one second does not give sufficient resolution. This avoids the need to switch directly to a time-wasting 10 second measurement period.

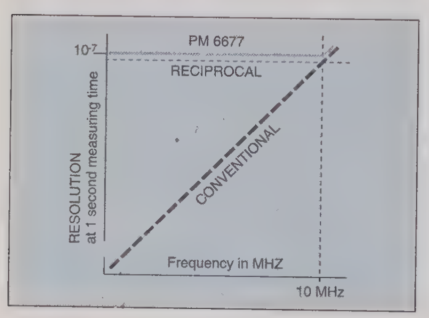


Fig. 1. The PM 6670 series counters benefit from both RECIPROCAL and CONVENTIONAL measuring principles. Automatic selection of the measuring mode always gives the best possible resolution.

Choice of Time Base Oscillator

The time base crystal oscillator determines the accuracy limit of the counters.

As shown in our crystal oscillator summary table that even the most stable version (5×10^{-10}/24h) can be operated from internal batteries. This unique feature is achieved by specially developed oven-stabilized crystal oscillators with extremely low power consumption. Thus laboratory accuracy is now available for field applications – without irritatingly long warm-up times after changing location.

By means of the external reference input, the user's own frequency standard can be used, when available.

Frequency Average

The use of microcomputers provides new opportunities in frequency measurements. The computing measuring principle, with synchronized sample-taking, enables frequency and period measurements to be made during one or a great number of measuring intervals. Start and duration of these intervals are controllable via an external gate input.

Individual samples may be as short as 500 ns or as long as 96 seconds.

Multiple-burst-frequency measurements or sampling frequency-sweep-profiles can be activated by a single control.

Specifications

Measuring Functions

Frequency

Range

Sine: 10 Hz to 120 MHz (PM 6673); 10 Hz to 550 MHz (PM 6674); 10 Hz to 600 MHz (PM 6675); 10 Hz to 1.5 GHz (PM 6676); 10 Hz to 2.3 GHz (PM 6677)
Pulse: Minimum frequency down to 0.1 Hz
Modes: Reciprocal and Conventional. For the highest possible resolution for both LF and HF measurements, the counter employs the Reciprocal mode for LF signals. Above 10 MHz it automatically uses the Conventional mode. For special applications, one can select either Reciprocal or Conventional.
Signal Mode: CW, Single Burst, Multiple Burst, or Frequency Average. In the Frequency Average mode (rear panel selectable), the counter measures the average of a multiple of frequency samples. Samples are taken with external gate control (≥500 ns) and totalized during the selected measuring time (10 ms to 96s) to allow multiple burst frequency measurements or to sample frequency sweep profiles.
LSD Displayed: 10^{-8} Hz to 10^{3} depending on measuring time and input frequency. At least 7 digits displayed per second of measuring time.
Resolution: LSD*

Inaccuracy (Relative Error)

$$\pm\frac{\text{Resolution}}{\text{FREQ}} \pm \text{Relative Trigger Error*}$$

± Time Base Error

**See definitions*

Period Average

Range: 100 ns to 100s
LSD Displayed: 10^{-16}s to 10^{-6}s, depending on measuring time and peak duration. At least 7 digits displayed per second of measuring time.
Resolution: LSD*

Inaccuracy (Relative Error)

$$\pm\frac{\text{Resolution}}{\text{PERIOD}} \pm \text{Relative Trigger Error*}$$

± Time Base Error

**See definitions*

Ratio

Range

$$\frac{\text{Freq A}}{\text{Freq D}} = \frac{\text{10 Hz to 120 MHz}}{\text{1 kHz to 10 MHz}} \text{ (PM 6673)}$$

$$\frac{\text{Freq A or B}}{\text{Freq D}} = \frac{\text{10 Hz to 550 MHz}}{\text{1 kHz to 10 MHz}} \text{ (PM 6674)}$$

$$\frac{\text{Freq A or B}}{\text{Freq D}} = \frac{\text{10 Hz to 600 MHz}}{\text{1 kHz to 10 MHz}} \text{ (PM 6675)}$$

$$\frac{\text{Freq A or B}}{\text{Freq D}} = \frac{\text{10 Hz to 1.5 GHz}}{\text{1 kHz to 10 MHz}} \text{ (PM 6676)}$$

$$\frac{\text{Freq A or B}}{\text{Freq D}} = \frac{\text{10 Hz to 2.3 GHz}}{\text{1 kHz to 10 MHz}} \text{ (PM 6677)}$$

LSD Displayed: 10^{-8} to 10^{0}; depending on measuring time and ratio
Resolution: LSD*

Inaccuracy (Relative Error)

$$\pm\frac{\text{Resolution}}{\text{RATIO}} \pm \text{Relative Trigger Error* D}$$

± Time Base Error

**See definitions*

Count

Totalize Range: 1 to 10^{17} with indication of pulses, M-pulses and G-pulses beyond the 10^{9} display range
Frequency Range: Sine, 10 Hz to 10 MHz; Pulses, 0 Hz to 10 MHz. Sequential start-stop periods are accumulated or individually totalized after reset.

Reset

Manual via pushbutton or electrical via input E

Input and Output Specifications

LF-Input (Channel A)

Frequency Range: 10 Hz to 120 MHz
Sensitivity: Sine, 10 mV rms (20 Hz to 120 MHz), 6 dB down at 10 Hz; Pulse, 30 mV p-p, (0 Hz to 120 MHz), minimum pulse duration 4 ns
Attenuation: Continuously variable in two ranges between x1 to x500. Noise immunity band (hysteresis band) can be continuously adjusted over the range: 20 mV p-p to 10V p-p nominal
Noise Filter: Switchable 50 kHz low pass filter. Noise suppression ≥20 dB at 500 kHz.
Impedance: 1 MΩ//≤25 pF
Trigger Level: Switchable with waveform selection for optimum triggering on signals of various duty factors.
⎍___ : for duty factor of <0.25
⌒_/ : for duty factor of 0.25 to 0.75
⎺⎺⎺⊔⎺ : for duty factor of >0.75
Coupling: AC
Maximum Voltage Without Damage: DC, 300V; ac, 260V rms at ≤440 Hz declining to 12V rms at ≥1 MHz

RF-Input (Channel B)

Frequency Range
PM 6674: 50 MHz to 550 MHz; 6x prescaled
PM 6675: 50 MHz to 600 MHz; direct gating
PM 6676: 100 MHz to 1.5 GHz; 16x prescaled
PM 6677: 0.1 GHz to 2.3 GHz; 16x prescaled

Operating Input Voltage Range
PM 6674: 10 mV rms to 12V rms
PM 6675: 5 mV rms to 12V rms
PM 6676: 10 mV rms to 12V rms, 0.1 GHz to 1 GHz; 30 mV rms to 12V rms, 1 GHz to 1.5 GHz
PM 6677: 20 mV rms to 12V rms, 100 MHz to 300 MHz; 10 mV rms to 12V rms, 0.3 GHz to 2 GHz; 25 mV rms to 12V rms, 2 GHz to 2.3 GHz

PM 6673, PM 6674, PM 6675, PM 6676 & PM 6677

AM Tolerance: 94% at max 100 kHz modulation frequency. Minimum signal must exceed minimum operating input voltage requirement.
Input Impedance: 50Ω nominal
VSWR: <2.0:1, 50 MHz to 1500 MHz; <2.5:1, 1.5 GHz to 2 GHz; <3.5:1, 2 GHz to 2.3 GHz
Maximum Voltage Without Damage: 12V rms, overload protection with pin diodes

External Reference and Ratio Input (Channel D)

Frequency Range: 1 kHz to 10 MHz
Sensitivity: 500 mV rms
Impedance: Approx 2 kΩ
Coupling: AC
Max Voltage Without Damage: 25V rms

Note: As external reference frequency, only 10 MHz will give correct decimal point and unit indication. With the optional frequency multiplier PM 9697 references of 1 MHz and 5 MHz can also be accepted.

Ext Arming/Burst/Reset (Channel E)

Arming: A high-to-low going pulse arms the counter to start a new measurement. Arming is not applicable in COUNT mode.
Burst Average: For frequency or period measurements, the measurement is interrupted when input E is high. The measurement is restarted when input E is low.
Frequency Range: <100 MHz
Mode: Reciprocal

Ext. Reset-Start: Counter is reset when input E goes high
Input Levels: High, ≥2V; low, ≤0.5V
Input Impedance: Approx 2 kΩ
Max. Input Voltage Without Damage: ±25V
Minimum Pulse Duration: Arming and frequency average: 500 ns; external reset: 200 µs

Time Base Oscillator Output

Crystal Frequency: 10 MHz
Output Level: Low, <0.4V (Z ≥10 kΩ); high, >3.5V (Z ≥10 kΩ)
Output Impedance: Approx 400Ω
Coupling: DC
Overload Protection: Short-circuit proof

Battery Unit (PM 9693)

Battery Capacity (typical at 20°C): 30 Wh sufficient for >3 hours operation or 20 hours standby
Battery Voltage: 12V nominal
Recharging Time: 8h to approx 75% or 12h to >90% of full capacity
Recharging Power: From counter <12W
Battery Low Indication: By blinking display 10-15 min before recharging is needed
Temperature: Operating, 0°C to +40°C; storage, -40°C to +50°C
Weight: 1.4 kg (3.1 lb)

Analog Recorder Output (PM 9695)

Installation: Inside the counter
Decade Conversion: Any 3 consecutive digits can be selected with a 12-position switch
Normal Mode: Analog output is directly proportional to digital input. 000 produces 0.000V.999 produces 0.999V
Output: Zero output, 0V; full-scale deflection, 0.999V
Accuracy: ±2 mV
Nonlinearity: ±0.5 mV
Delay: Output voltage setting time <100 ms after end of measurement
Temperature Coefficient: ±(0.1 mV + 0.03% of reading)/°C
Output Impedance: 100Ω ±1%

GPIB/IEEE-488 Interface (PM 9696B)

Installation: Inside the counter
Programmable Functions: Frequency A, Frequency B, Period A, Ratio A/D or B, D, Count A, display hold, trigger, device clear, measuring time
Interface Function Repertoire: SH1, AH1, T5, L4, R1, RL1, DC1, DT1 and E1
Data Output Rate: 10 to 20 readings per second

Auxiliary Functions

Measuring Time

The measuring time is "continuously" variable (33 steps/decade): 10 ms to 96s

On/Stand by

In "ST BY" position, power is available to maintain an ovenized crystal oscillator heated and to recharge the optional battery pack

Check

10 MHz internal reference connected to logic circuitry. Self-test of most measuring functions can be selected.

Display Hold

Depressing "DISP HOLD" button sets display time to infinite and freezes the last measurement result. A new measurement can be initiated using reset.

Definitions

LSD Displayed

Unit value of Least Significant Digit displayed

For Frequency <10 MHz or Period Average

$$\text{LSD} = \frac{2.5}{\text{Measuring Time}} \times \frac{\text{FREQ or PERIOD}}{10^7\ \text{Hz}}$$

For Frequency >10 MHz

$$\text{LSD} = \frac{2.5 \times \text{Prescaling Factor}^{(p)}}{\text{Measuring Time}}$$

For Ratio

$$\text{LSD} = \frac{2.5 \times \text{Prescaling Factor}^{(p)} \times \text{RATIO}}{\text{Measuring Time} \times \text{FREQ A or B}}$$

All calculated LSDs shall be rounded to nearest decade (e.g. 5 ns will be 10 ns and 0.4 Hz will be 0.1 Hz) and cannot exceed the 9th digit

(p) = 1 Channel A, all models
(p) = 6 Channel B, PM 6674
(p) = 1 Channel B, PM 6675
(p) = 16 Channel B, PM 6672, PM 6676, PM 6677

Resolution

Smallest increment between two measuring results is 1 LSD unit (10% probability) or 2 LSD units (30% probability) but can then be reduced to 1 LSD unit by doubling the measuring time

The Resolution is 2 LSD Units

$$\text{if: LSD} < \frac{1}{\text{Measuring Time}} \quad (\text{Freq} > 10\ \text{MHz})$$

$$\text{or if } \frac{\text{LSD} \times \text{Measuring Time}}{\text{FREQ or PERIOD or RATIO}} < 10^{-7}\text{s}$$

In all other cases the resolution is 1 LSD unit

Relative Trigger Error

For any Waveform

$$\frac{\text{Peak-to-Peak Noise Voltage}}{\text{Signal Slope (V/s)} \times \text{Measuring Time}}$$

For Sinewave

$$\frac{1}{\text{FREQ} \times \text{Measuring Time} \times \pi \times \text{S/N ratio}}$$

Example: For S/N ratio of 100 (40 dB) and 1 second measuring time, the trigger error is:

$$\frac{3 \times 10^{-3}}{\text{FREQ}}$$

General Specifications

Display

Readout: 9 digits, 11 mm high-efficiency LEDs. Microprocessor control of display format, decimal point and unit indication: Hz, kHz, MHz, GHz, ns, µs, ms and s.
Display Time: Continuously variable 80 ms to 96s plus DISP HOLD
Gate Lamp: Indicates that main gate is opened and measurement takes place
ST BY: Stand by indication with LED when instrument is not switched ON
REMOTE: Indicates when control over counter is taken by the installed bus interface option (GPIB/IEEE-488)

Power Requirements

These counters can be powered from line voltage, and optional battery or external battery voltage.

Line: 115/230V ±15%; 45 Hz to 440 Hz; <25 VA
Internal Battery Unit: PM 9693
External DC Source: 11.8V to 28V <8W
Line Interference: Below VDE 0871 (B) and MIL-STD 461
Safety: According to IEC 348 and CSA 556B

PM 6673, PM 6674, PM 6675, PM 6676 & PM 6677

Environmental Data

Temperature

Rated Range of Use: -5°C to +50°C
Functional Operation: -10°C to +55°C
Storage and Transport: -40°C to +70°C
Humidity: Operating, 10% to 90% RH, no condensation; storage, 5% to 95% RH
Altitude/Barometric Pressure: Operating, 5000m (15,000 ft); storage, 15000m (5000 ft)

Mechanical Data

Size: 210 mm W x 89 mm H x 280 mm L (8.25 in W x 3.8 in H x 11 in L)
Weight: 2.5 kg (5.5 lb)

Ordering Information

Models

PM 6673 120 MHz Counter, standard oscillator 5 x 10^{-7}/month
PM 6674 As PM 6673 but with frequency range to 550 MHz
PM 6675 As PM 6673 but with frequency range to 600 MHz (direct gated)
PM 6676 As PM 6673 but with frequency range to 1.5 GHz
PM 6677 As PM 6673 but with frequency range to 2.3 GHz

Included with Instrument

One-year product warranty, line cord, operator manual, and Certificate of Calibration Practices.

Optional Configurations

When ordering, select basic "PM" Model desired from above, plus construct a 3-digit suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface.

Input Frequency Option

/0-- 120 MHz for PM 6673
/1-- 600 MHz (direct gated) for PM 6675 only
/3-- 550 MHz for PM 6674 only
/4-- 1 GHz for PM 6672 only
/5-- 1.5 GHz for PM 6676 only
/6-- 2.3 GHz for PM 6677 only

Reference Oscillator Option

/-1- Standard
/-2- TCXO (PM 9678B/01)
/-4- Very High Stability Crystal Oscillator (PM 9690/01)
/-5- Ultra High Stability Crystal Oscillator (PM 9691/01)
/-8- Externally Referenced Frequency Multiplier (PM 9697/00), with Standard Oscillator only

Interface Option

/--1 Standard, non GPIB/IEEE-488
/--3 Battery (PM 9693/00) for all except PM 6670
/--5 Analog Output (PM 9695/00) for all except PM 6670
/--6 GPIB/IEEE-488 (PM 9696B/00) for all except PM 6670

Example, Ordering Configuration

To order the PM 6673 with standard 120 MHz input, temperature compensated oscillator, & no interface, select:

		Model PM 6673
Configuration		
Option Suffix -	Input	/0--
	Oscillator	/-2-
	Interface	/--1
Yields Complete Model Number		PM 6671/021

Options and Accessories

PM 8912/09 1.5 GHz, 5 kΩ Probe Set, 1:100
PM 8943A/003 650 MHz, 50Ω/1 MΩ FET Probe
PM 9021/001 120 MHz, 1 MΩ Probe Set, 1:1 and 1:10
PM 9581/01 50Ω Feedthrough Termination 3W
PM 9585/01 50Ω Feedthrough Termination 1W
PM 9672/70 Carrying Case
PM 9678B/01 Temperature Compensated Osc.
PM 9690/01 Very High Stability Oscillator
PM 9691/01 Ultra High Stability Oscillator
PM 9693/00 Battery Unit
PM 9695/00 Analog Recorder Output
PM 9696B/00 IEEE-488 Bus Interface
PM 9697/00* External Reference Frequency Multiplier

PM 6671 to PM 6677 can be equipped with max one of these options: PM 9693, PM 9695 or PM 9696B.

**The PM 9697 multiplier can only be installed simultaneously with the /01 oscillator. For installation in other versions the oscillator has to be removed first.*

Manuals

PM 6673-77 Operators*
PM 6673-77 Service

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty

One-year product warranty.

Quick Reference Performance Survey

	PM 6673	PM 6674	PM 6675	PM 6676	PM 6677
Frequency A **Frequency B** **Prescaling Factor**	120 MHz — —	120 MHz 550 MHz B	120 MHz 600 MHz 1	120 MHz 1.5 GHz 16	120 MHz 2.3 GHz 16
Sensitivity A **Sensitivity B**	10 mV —	10 mV 10 mV	10 mV 5 mV	10 mV 10 mV	10 mV 10 mV
Period, Count **Ratio A/D** **Ratio B/D**	10 MHz 120/10 MHz —	10 MHz 120/10 MHz 550/10 MHz	10 MHz 120/10 MHz 600/10 MHz	10 MHz 120/10 MHz 1500/10 MHz	10 MHz 120/10 MHz 2300/10 MHz

Choice of Crystal Oscillators

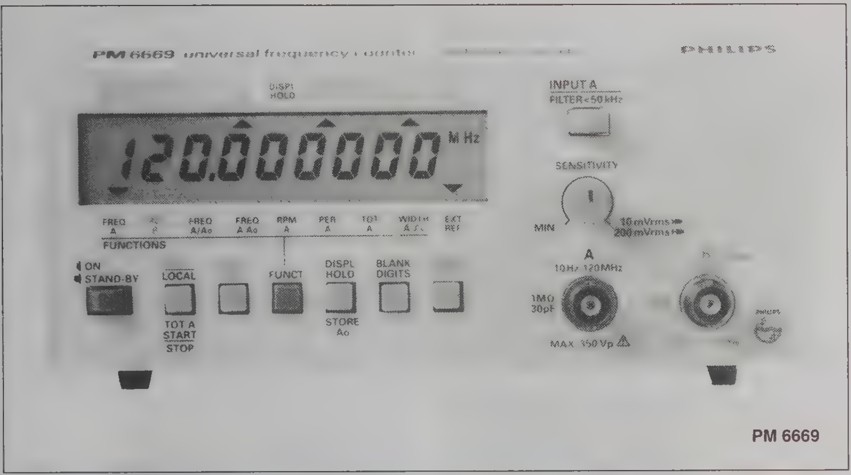
PM 667./ to Version Including Time Base Option	**/.1. Standard Version**	**/.2.Version PM 9678B**	**/.4.Version PM 9690**	**/.5.Version PM 9691**
Stability Against	Standard	TCXO	Oven	Oven
Aging: /24h /Month /Year	N/A <5 x 10^{-7} <5 x 10^{-6}	N/A <1 x 10^{-7} <5 x 10^{-7}	<1.5 x 10^{-9*} <3 x 10^{-8} <1.5 x 10^{-7}	<5 x 10^{-10*} <1 x 10^{-8} <7.5 x 10^{-8}
Temperature: 0°C to 50°C Ref. to +23°C	<1 x 10^{-5}	<1 x 10^{-6}	<3 x 10^{-8}	<5 x 10^{-9}
Line Voltage: ±10%	<1 x 10^{-8}	<1 x 10^{-9}	<5 x 10^{-10}	<5 x 10^{-10}
Warm-up time to reach 10^{-7} of final value	N/A	N/A	<15 min	<15 min

**After 48 hours of continuous operation.*

PM 6662 & PM 6669

Available through Distributors

GPIB
IEEE-488



PM 6669

PM 6662 & PM 6669 Frequency Counters

- Unrivalled price/performance
- High resolution reciprocal counting
- Error-free triggering
- High stability MTCXO: 2x10^{-7} over 0°C to 50°C with pushbutton calibration
- Eight measuring modes including PULSE WIDTH
- Versatile use with the GPIB/IEEE-488 interface or battery operation
- 120 MHz/1.3 GHz option

The PM 6662 and PM 6669 are economic, easy-to-use counters that meet the most stringent demands for high-precision measurements, reliability and durability.

The PM 6662 handles frequency measurements, while the multi-function PM 6669 offers period, count totalization, ratios, pulsewidth and frequency difference measurements.

Available options for further enhancement include a 1.3 GHz input, battery pack and high-stability MTCXO time base oscillator for both models, and a GPIB/IEEE-488* interface for the multi-function PM 6669.

No-Compromise Quality

- 70,000 hour MTBF
- Designed for MIL standard T-228800 requirements
- Ruggedized, all-metal construction
- Low component count and low power dissipation through single-chip LSI design

High-Precision, Reliable Counting

- High-resolution computed counting gives ≥7 digits/s resolution
- Unique high-stability MTCXO time base
- Error-free, automatic triggering and high noise immunity input circuitry
- Exellent suppression of RF interference through all-metal cabinet

Easy Operation

- Auto-triggering
- Auto-ranging and auto-display formating

The Versatile Counter – PM 6669

The PM 6669 offers as many as 8 measuring functions, including pulse width and relative frequency measurements; functions normally found only in more expensive timer/counters.

A wide range of configurations optimize the counter to meet your specific requirements. The PM 6669 can be used on the test bench, in GPIB/IEEE-488 systems (with the optional GPIB/IEEE-488 interface and rack mount kit), or for field service (using the optional battery pack and carrying case).

You can order enhanced performance options, including the 1.3 GHz input or the high-stability MTCXO time base oscillator. Best of all, these options can be retrofitted at any time, when ever you need them.

The PM 6669 has a full 9-digit display, to allow complete presentation of measuring results (as when using an external reference frequency). When less accurate measurements are made, blanking of irrelevant display digits facilitates readout of your results.

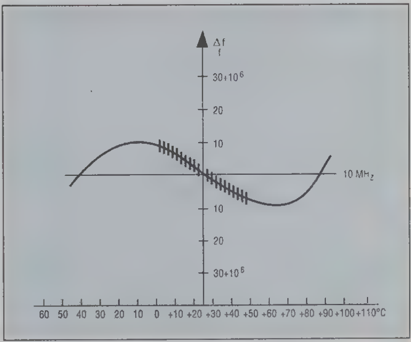
MTCXO Time Base

Counter stability and precision have always been limited by the time base crystal oscillator. Achieving really high stability demanded the use of costly oven-stabilized oscillators. Low cost instruments had to make do with standard crystal oscillators or TCXOs (Temperature Compensated Crystal Oscillator).

The PM 6662 and PM 6669 counters break through the traditional price/stability barrier with the unique MTCXO (Mathematically Temperature Compensated Crystal Oscillator). The temperature dependency curve for each individual crystal oscillator is factory measured, and the frequency deviations across the temperature range (Δf) are stored in a non-volatile memory.

During operation, the Δf value for the operating temperature is referenced in memory and used to compensate the measuring result before it is displayed. This automatic temperature compensation also results in highly accurate measurements instantly, without the long warm-up times.

The unique MTCXO principle gives a residual temperature stability of 2 x 10^{-7} over the temperature range 0° to 50°C, a value comparable to that of oven-stabilized oscillators, but at much lower cost.



The ΔF characteristics for each MTCXO crystal are factory-measured and stored in a look-up table in a non-volatile memory. The ΔF value for any operating temperature is looked up during operation, and used to correct the measured frequency value before display.

High-Resolution Counting

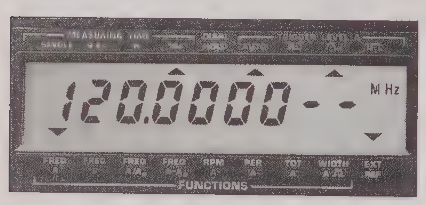
Synchronized multiple-period measurements, with computation of the reciprocal value, allow high-resolution measurements on input signals of any frequency. The microprocessor in the PM 6662 and PM 6669 counters eliminates traditional ±1 input cycle errors, giving a resolution of at least 7 digits in a measuring time of 1 second, even on low-frequency signals.

*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

PM 6662 & PM 6669

Frequency Counter Selection Table

	PM 6662	PM 6669
Freq. A	10 Hz to 160 MHz	10 Hz to 160 MHz
Freq. B	70 MHz to 1.3 GHz	70 MHz to 1.3 GHz
Measuring Modes		Freq. A, Freq. B, Period A, RPM A, Tot. A, Freq. A/A_0, Freq. $A-A_0$, Pulse width A
Other facilities	–	Display hold, Reset, Digit blanking
Measuring times	0.2, 1 and 10s	0.2, 1, 10s and SINGLE
Sensitivity A	15 mV	10 mV
Sensitivity B	10 mV	10 mV
Trigger level offset	100% foolproof auto-trigger on any input duty factor	Manually set (+, 0, –) or auto-setting
Input A attenuator	x1 to x300, 6 steps	x1 to x400, cont. variable
Noise suppression filter	–	50 kHz
Options	Battery pack, rack mount, MTCXO time base, 1.3 GHz input	Battery pack, rack mount, MTCXO time base, 1.3 GHz HF input, GPIB interface



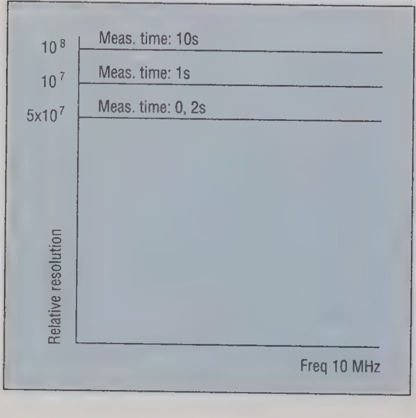
Readout of results is facilitated by blanking of irrelevant display digits – a useful feature when, for example, measurements do not require the counter's maximum accuracy.

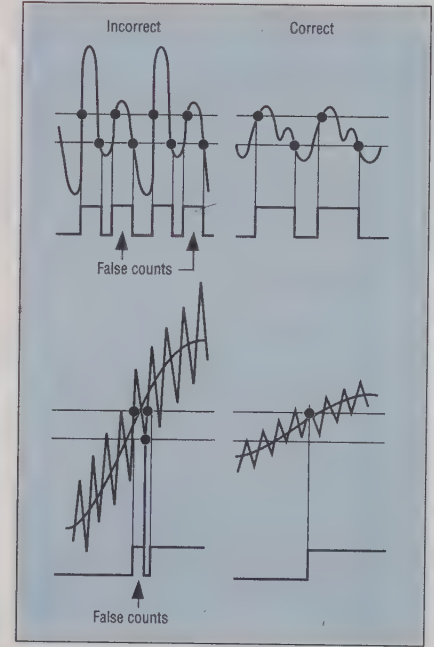
So with the PM 6662 and PM 6669, there is no need for long gate times or manual conversion of period values to get the high-resolution frequency measurements you need.

Frequency Range up to 1.3 GHz

In their standard configuration, the PM 6662 and PM 6669 counters are guaranteed to measure frequencies up to 120 MHz under all conditions (typically 160 MHz at room temperature). The optional HF input extends the range right up to 1.3 GHz, often required, for instance, for measurements on telecommunications equipment.

The HF input has a very wide operating voltage range, from 10 mV rms to 12V rms, to suit a wide variety of applications.





A variable input attenuator enables correct matching of the input signal to the trigger sensitivity of the counter. False counts caused by interference, distortion and noise are thereby prevented.

Smart and Simple - PM 6662

For frequency measurements, the PM 6662 combines the same high accuracy as the PM 6669 with simple, foolproof operation every time.

The AUTO DISPLAY function always gives the correct range (Hz, kHz or MHz) and resolution for any input frequency and selected measuring time.

AUTOTRIGGER automatically sets the right trigger level to ensure correct triggering, whatever the waveform. A choice of measuring times allows for the optimum selection of measuring speed versus accuracy, and selection of sensitivity over a wide range lets you suppress the influence of noise.

Specifications

Measuring Functions

Frequency A or B (optional)

Frequency Range: Freq A: 10 Hz to 120 MHz (typically to 160 MHz); Freq B: 70 MHz to 1.3 GHz (PM 9608B)
Mode: Reciprocal frequency measurement
LSD Unit Displayed:

$$\frac{2.5 \times 10^{-7} \times \text{FREQUENCY}}{\text{measuring time}}$$

Frequency A/A_0 (PM 6669 only)

FREQ A measurement is divided by the constant A_0 before display. A_0 is read in frequency mode using the STORE button. At power-on A_0 is set to 1 (default).

Frequency A/A_0 (PM 6669 only)

FREQ A measurement is subtracted by the constant A_0 before display. A_0 is read in frequency mode using the STORE button. At power-on A_0 is set to 0 (default).

RPM A (PM 6669 only)

FREQ A measurement is multiplied by 60, and displayed as revolutions per minute (RPM).
Range: 6 RPM to 720 x 10^6 RPM

Period A (PM 6669 only)

Range: 8 ns to 2 x 10^8s
Mode: Single period measurement (SINGLE) or period average measurement (at 0.2, 1 or 10s measuring times)

LSD Displayed
SINGLE Period Measurement:

100 ns (TIME <100s)

$$\frac{5 \times \text{PERIOD}}{10^9\text{s}}$$ (TIME >100s)

Period Average Measurement:

$$\frac{2.5 \times 10^{-7} \times \text{PERIOD}}{\text{measuring time}}$$

Totalize A (PM 6669 only)

Event counting is controlled by the START/STOP button. Sequential start-stop counts are accumulated.
Range: 0 to 1 x 10^{15} with indication of k or M (kilopulses or mega-pulses). The result is truncated to 9 digits.

Frequency Range: Sine wave: 10 Hz to 12 MHz; Pulse: 0 Hz to 12 MHz
Pulse Pair Resolution: 80 ns

Width A (PM 6669 only)

A positive pulse width measurement is performed. Measuring time selection is not valid (always SINGLE)
Range: 100 ns to 2 x 10^8 s
LSD Displayed: 100 ns (TIME < 100 s)

$$\frac{5 \text{ x WIDTH}}{10^9 \text{ s}} \quad (\text{TIME} \geq 100 \text{ s})$$

Input Specifications

Input A (PM 6662 only)

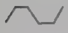
Frequency Range: 10 Hz to 120 MHz (typically to 160 MHz)
Coupling: AC
Impedance: 1 MΩ//30 pF

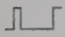
Max Sensitivity: Sine wave: 30 mV rms, 10 Hz to 100 Hz; 15 mV rms, 100 Hz to 75 MHz; 30 mV rms, 75 MHz to 120 MHz; 60 mV rms, typically: 120 MHz to 160 MHz. Pulse: 90 mVp-p, 10 Hz to 100 Hz; 45 mV p-p, 100 Hz to 75 MHz; 90 mV p-p, 75 MHz to 120 MHz.
Minimum Pulse Duration: 4 ns
Attenuation: x1, x3, x10, x30, x100 and x300. The attenuation selector is labelled sensitivity: 15 mV, 50 mV, 150 mV, 500 mV, 1.5V, 5V.
Auto Trigger Level: A fixed (+, 0 or –) trigger level offset is automatically applied to ensure correct triggering on any waveform and duty cycle
Maximum Voltage Without Damage: 350V (dc + ac peak) dc to 440 Hz falling to 12V rms at 1 MHz

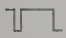
Input A (PM 6669 only)

Frequency Range: 10 Hz to 120 MHz (typically up to 160 MHz with 30 mV rms input signal)

Sensitivity: Sine: 10 mV rms, 10 Hz to 120 MHz (30 mV rms typically, 120 MHz to 160 MHz). Pulse: 30 mV p-p 0 Hz to 120 MHz.
Coupling: AC
Impedance: 1 MΩ//30 pF
Attenuation: Continuously variable in two ranges between x1 and x400
Filter: Switchable 50 kHz low pass noise filter with a suppression of 20 dB at 200 kHz.
Trigger Levels: 3 different levels for triggering on signals with various duty factors, and AUTO:


used for symmetrical input signals with a duty factor of 0.25 to 0.75;


used for input signals with duty factor <0.25;


used for input signals with duty factor >0.75.

AUTO Trigger Level: The counter selects a suitable trigger level setting automatically (not active in TOT-A measurements)

Input Signal
Repetition Rate: >100 Hz
Trigger Slopes (GPIB/IEEE-488 only): + or –
Maximum Voltage Without Damage: 350V (dc + ac peak) between dc and 440 Hz, falling to 11V rms at 1 MHz

Input B (Option PM 9608B)

Frequency Range: 70 MHz to 1.3 GHz
Coupling: AC
Operating Input Voltage Range:
10 mV rms to 12V rms, 70 MHz to 900 MHz;
15 mV rms to 12V rms, 900 MHz to 1100 MHz;
40 mV rms to 12V rms, 1100 MHz to 1300 MHz
AM Tolerance: 94% at max 100 kHz modulation frequency. Minimum signal must exceed minimum operating input voltage requirement.
Input Impedance: 50Ω nominal, VSWR <2:1
Max Voltage Without Damage: 12V rms; overload protection with pin diodes

External Reference Input

The external reference input is automatically selected when an external signal of 9.9 MHz to 10.1 MHz is connected.
Input Frequency: 10 MHz ±0.1 MHz
Coupling: AC
Operating Input Voltage Range: 500 mV rms to 15V rms (sine)
Maximum Voltage Without Damage: 15V rms
Impedance: Approx 300Ω at 10 MHz

Definitions

LSD Displayed

LSD = Unit value of least significant digit displayed. All calculated LSDs should be rounded to the nearest decade (e.g. 0.3 Hz is rounded to 0.1 Hz and 5 Hz to 10 Hz) and cannot exceed the 9th digit.

Resolution

Resolution = Smallest increment between two measuring results on the disply, due to the 1 count error
Freq A, B, Period A: Resolution can be 1 LSD unit or 2 LSD units.

If: $\frac{\text{LSD x Measuring time}}{\text{FREQ or PERIOD}} < 10^{-7}$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).
SINGLE Period A and Width A: Resolution = 1 LSD unit.

Inaccuracy

Inaccuracy, i.e., the relative error, depends on the following factors:

$$\pm \frac{\text{Resolution}}{\text{FREQ, PERIOD or WIDTH}}$$

± relative trigger error
± relative time base error

Relative Trigger Error
Frequency A, Period A:

$$\pm \frac{\text{noise voltage A (Vp-p)}}{\text{signal slope A (V/s) x meas. time}}$$

Relative Time Base Error:

$$\pm \frac{\text{deviation from 10 MHz}}{\text{10 MHz}}$$

Note: For WIDTH measurements, triggering on 50% of amplitude will occur only if the signal duty factor is 0.5. In other cases the timing error caused by wrong trigger level setting should be added to inaccuracy.

General Specifications

Power Requirements

Line Voltage: 115V or 230V ±15%, 45 Hz to 440 Hz, less than 20 VA
Fuse: Internal thermal fuse in mains transformer
Line Interference: Below VDE 0871B

Time Base
Alternatives: Standard built-in crystal oscillator. Order no. PM6662/.1. or PM 6669/.1. MTCXO, Order no. PM 6662/.3. or PM 6669/.3. The MTCXO can be separately ordered (option PM 9607) for later upgrading of the counter.

Osc. Version	Standard	MTCXO
Stability against: Aging/month /year	$<5 \times 10^{-7}$ $<5 \times 10^{-6}$	$<1 \times 10^{-7}$ $<5 \times 10^{-7}$
Temperature 0°C to 50°C	$<1 \times 10^{-5}$	$<2 \times 10^{-7}$
Line voltage change 10%	$<1 \times 10^{-8}$	$<1 \times 10^{-9}$
Change in supply line/battery	$<5 \times 10^{-7}$	$<1 \times 10^{-8}$

Display
Readout: 9-digit LCD with unit indication
Gate Indicator: Indicates gate open, i.e. measurement activity

Cursors
PM 6662: Indicate used input (A or B), measuring time and use of ext. reference frequency
PM 6669: Indicate selected measuring function, measuring time, input triggering, display hold and use of ext. reference frequency

Measuring Time/Rate
PM 6662: 0.2, 1 and 10s
PM 6669: 0.2, 1, 10s and SINGLE
Note: SINGLE selected in PERIOD or WIDTH, results in a single cycle measurement. SINGLE in FREQUENCY or RPM, results in a fixed measuring time of 3 ms

Display Time: The display time equals measuring time plus approx 100 ms
Maximum Measuring Rate: Approximately 5 measurements/s (standard oscillator) or 2 measurements/s (MTCXO)

Environmental Data

Warm-up Time to Reach Specification: 5 min.

PM 6662 & PM 6669

Temperature
Storage: -40°C to +70°C
Operating: 0°C to +50°C
Altitude: Operating and non-operating; 4600m (15000 ft)
Humidity: 95% R.H.; 0°C to 40°C
Vibration: Operating; 15 min along each of the 3 major axis, 10 Hz to 150 Hz, 0.3 mm p-p displacement and 2g max acceleration
Shock: Operating; 3 shocks along each of the 3 major axis, half sine wave, 6 ms duration and 40g acceleration pulses
Bench Handling: MIL-STD-810D method 516.3, procedure VI
EMC: Meets VDE 0871(B) and FCC part 15J
Safety: CSA Bulletin 556B certified and Philips certification to comply with IEC 348 Class I

Mechanical Data

Size
PM 6662: 186 mm W x 88 mm H x 220 mm L (7.3 in W x 3.5 in H x 8.7 in L)
PM 6669: 186 mm W x 88 mm H x 270 mm L (7.3 in W x 3.5 in H x 10.7 in L)

Net Weight
PM 6662: 1.6 kg (3.6 lb)
PM 6669: 2.1 kg (4.6 lb)

Shipping Weight
PM 6662: 2.6 kg (5.7 lb)
PM 6669: 3.1 kg (6.8 lb)
Cabinet: All-metal cabinet with a fold-down tilting support that also acts as a handle

Optional Accessories

GPIB Interface, PM 9604 (PM 6669 only)

Mounting: Inside counter cabinet
Interface Functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E2
Address Setting: Switch selectable between 0 and 30
Programmable Device Functions: All front panel settings except Power on/St by, sensitivity and filter on/off; plus Trigger Slope (pos/neg)

High-Speed Dump
The contents of internal registers are transferred to the controller, without being processed by the counter. The processing must be done in the controller instead.
Max Output Rate: Approx 100 readings/s

Maximum Data Output Rate
Normal Mode: Approx 5 readings/s
High-Speed Dump: Approx 100 readings/s

Output Time for Measuring Data
Normal Mode: Approx 15 ms (20 bytes)
High Speed Mode: Approx 6 ms (15 bytes)
Response Time for Addressing: Approx 600 µs
Response Time for Trigger Command (GET): Approx 10 ms
Typical Read Time for Programming Data: Approx 1 ms/byte

Battery Unit, PM 9605

The PM 9605 is a rechargeable battery unit for mounting inside the counter. The unit contains a standard 6V sealed lead-acid battery and an automatic battery charger.
Battery Capacity (20°C): Approx 15 Wh
Operating Time When Battery Powered: Approx 3 hours of continuous operation
Recharging Time: 7 hours to approx 75% of full capacity
Battery Protection: Overcharge protection and deep discharge (auto-shut-off) protection
Low Battery Indication: All display indications will blink when approx 15 minutes operation time is left

Temperature
Operating: 0°C to +40°C
Storage: -40°C to +50°C

Weight: 0.8 kg

Carrying Case, PM 9609

The PM 9609 is a simulated leather case to protect the PM 6662/69 counter during transportation.

Ordering Information

Models

PM 6662 Frequency Counter
PM 6669 Frequency Counter

Included with Instrument
One-year product warranty, line cord, operator manual, and Certificate of Calibration Practices.

Optional Configurations
When ordering, select either PM 6662 or PM 6669 mainframe, plus construct a 3-digit/ suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface.

Input Frequency Option
/0-- Standard 160 MHz
/4-- 1.3 GHz (PM 9608B/00)

Reference Oscillator Option
/-1- Standard
/-3- MTCXO (PM 9607/00)

Interface Option
/--1 Standard line voltage, non GPIB/IEEE-488
/--3 Battery (PM 9605/00)
/--6 GPIB/IEEE-488 (PM 9604/00) (for PM 6669)

Example, Ordering Configuration
To order the PM 6669 with standard 160 MHz input, MTCXO Oscillator, and no interface, select:

		Model
Configuration		PM 6669
Option Suffix -	Input	/0--
	Oscillator	/-3-
	Interface	/--1
Yields Complete Model Number		PM 6669/031

Options & Accessories
PM 9581/01 50Ω Termination, 3W
PM 9585/01 50Ω Termination, 1W
PM 9604/00 GPIB Interface (for PM 6669)
PM 9605/00 Battery Unit
HM 9606/00 Rack kit for PM 6662/6669 and 8840/2 or PM 2534/35 DMM
HM 9606/01 Rack kit for PM 6662/6669
PM 9607/00 MTCXO Time Base
PM 9608B/00 1.3 GHz HF-Input
PM 9609 Carrying Case
PM 9665B/01 50 kHz low-pass Filter, BNC-BNC (for PM 6662)

All options can be field installed by the user.

Note: Options PM 9604 and PM 9605 cannot be installed together in a PM 6669 Counter.

Manuals
PM 6662 Operator*
PM 6669 Operator*
PM 6669 Service

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

AVAILABLE THROUGH
DISTRIBUTORS

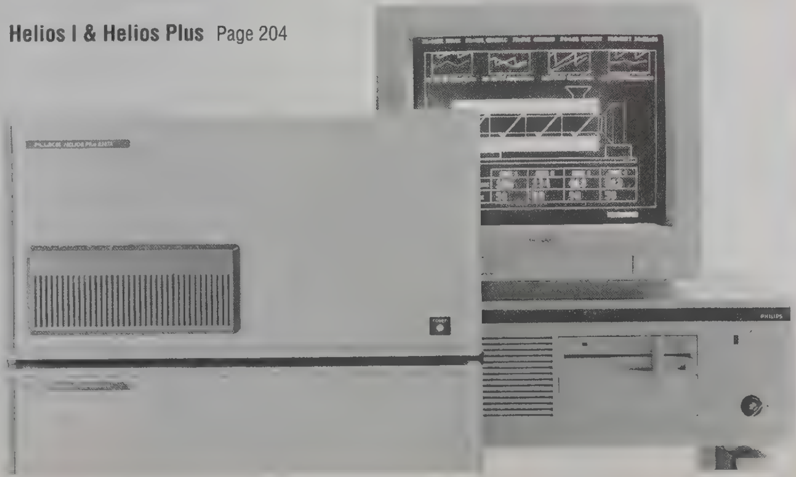
Data Acquisition

Wireless Logger™ 2625A/WL Page 198

2285B Page 200

Hydra Data Bucket 2635A Page 194

Helios I & Helios Plus Page 204



The Fluke family of data acquisition products include both PC-based and stand-alone instruments for monitoring electrical and physical parameters such as voltage, current, resistance, temperature, pressure and flow; and can accommodate applications requiring a few channels up to several hundred channels of analog or digital I/O.

Our new Wireless Logger allows you the freedom to collect real time data when and where you want, without wires! This new system transmits data using noise immune spread spectrum modulation and used with our new Windows™-based application software gives you a powerful, wireless, data acquisition system.

Housed in a small, portable package, the Hydra Series Data Acquisition Units are quick to set up and configure. There are three models to choose from: the 2620A Data Acquisition Unit, the 2625A Data Logger, and the 2635A Data Bucket. All three instruments support a wide variety of analog inputs via a Universal Input Module, eliminating the need for external signal conditioning.

Helios-I and the Helios Plus Data Acquisition Front Ends and application software convert your computer into a powerful data acquisition system. Helios-I provides high accuracy, noise rejection, and resolution, across a broad range of inputs. For higher speed sampling, Helios Plus adds a fast analog-to-digital converter that provides faster data capture and alarm checking up to 1000 readings per second in burst mode.

The 2280 Series Data Loggers feature menu-prompted set-up, totally eliminating software programming. The 2286A records data on an internal MS-DOS compatible 3½" floppy disk which can be loaded directly into a PC for analysis using popular spreadsheet programs.

Selection Guide & Features Page 192

Introduction Page 193

Data Loggers Page 194

Computer Front Ends Page 204

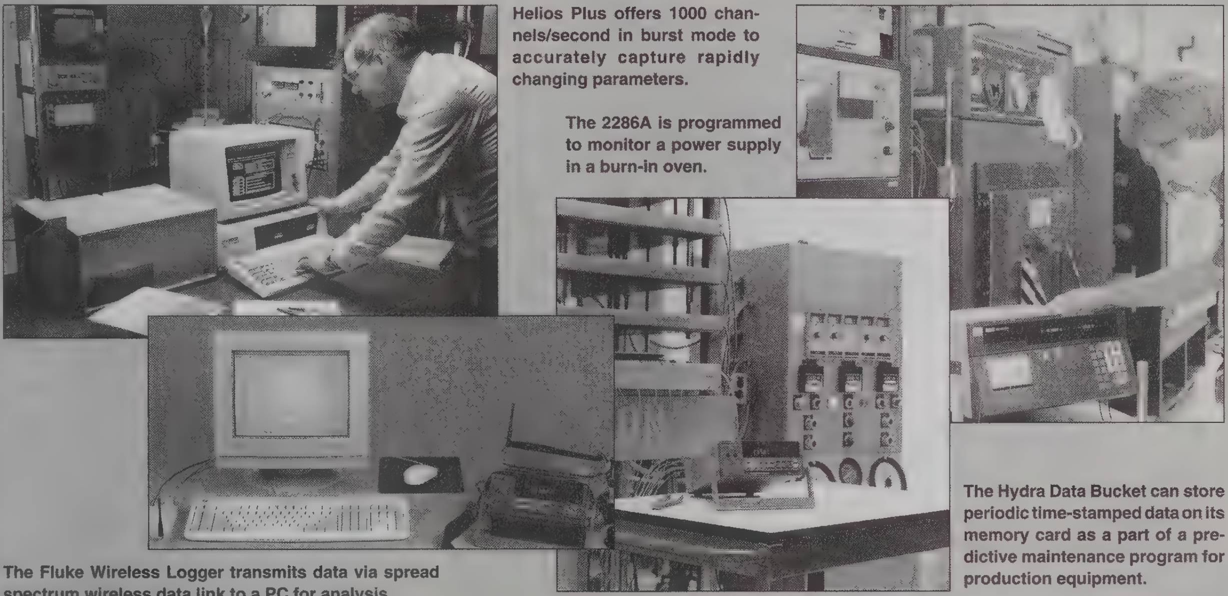
Data Acquisition System & Software Page 212

Selection Guide

	Hydra Series			Helios Series		2280 Series
Measurement	**2620A**	**2625A/2625A/WL**	**2635A**	**2287A**	**2289A**	**2285B/2286A**
Thermocouples	9 Types	9 Types	9 Types	11 Types	11 Types	11 Types
RTDs	100Ω Pt. 385	100Ω Pt. 385	100Ω Pt. 385	All Types	All Types	All Types
Resistance	To 10 MΩ	To 10 MΩ	To 10 MΩ	To 64K	To 64K	To 64K
DC Voltage Ranges	100 mV-150V[7], 300V[1]	100 mV-150V[7], 300V[1]	100 mV-150V[7], 300V[1]	64 mV-64V	64 mV-64V	64 mV-64V
Max DC Resolution	1 µV	1 µV	1 µV	0.5 µV	0.5 µV	1 µV
AC Voltage Ranges	300 mV-150V, 300V[1]	300 mV-150V, 300V[1]	300 mV-150V, 300V[1]	250V	250V	250V
DC Current	4 to 20 mA[5]	4 to 20 mA[5]	4 to 20 mA[5]	0 to 64 mA	0 to 64 mA	0 to 64 mA
Strain Gage	–	–	–	Yes	Yes	Yes
BCD	–	–	–	Yes	Yes	Yes
Binary	–	–	–	Yes	Yes	Yes
Status (Contacts)	Yes	Yes	Yes	Yes	Yes	Yes
Counter	To 1 MHz	To 1 MHz	To 1 MHz	To 400 kHz	To 400 kHz	To 400 kHz[3]
Event Totalize	Yes	Yes	Yes	Yes	Yes	Yes
Outputs						
Status or Alarms (# of chs)	8	8	8	0-1000	0-1500	0-100[6], 0-1500[3]
Int Relays (Max)	–	–	–	–	–	1
User-Defined BCD	–	–	–	Yes	Yes	Yes
Analog Voltage	–	–	–	To ±10V	To ±10V	To ±10V[3]
Analog Current	–	–	–	4-20 mA	4-20 mA	4-20 mA
Features						
Analog Input Channels (maximum)	21	21	21	1000	1500	100[6], 1500[3]
Basic Accuracy (dc V)	0.02%	0.02%	0.02%	±.005%	±.005%	±.005%
Speed Channels/second	4/17	4/17	4/17	16 (High Res) 1000 (Med Res)[2]	16 (High Res)	15[4]
Instrument Set-up and Operation	Front Panel or Computer I/F	Front Panel or Computer I/F	Front Panel or Computer I/F	Computer I/F	Computer I/F	Front Panel or Computer I/F
RS-232C/IEEE-488	Std/Opt	Std/NA	Std/NA	Std/NA	Std/NA	Opt/Opt
12V DC Operation	Yes	Yes	Yes	Opt	Opt	Yes
Graphics	Via Host	Via Host	Via Host	Via Host	Via Host	Plot
Permanent Data Storage	Host	NV RAM	Removable RAM Card	Host	Host	3.5" Disk[3]
Built-in Printer	–	–	–	–	–	Yes
Battery Back-up	Program, Clock, Data	Program, Clock, Data	Program, Clock, Data	Definitions, Clock	Definitions, Clock	Program, Clock
PC Application Software	Yes	Yes	Yes	Yes	Yes	Yes
Page Number	196	196	196	204	204	200

1) 300V from front panel and channels 1 and 11
2) In burst mode A/Ds operate in parallel for even higher effective reading rates, 2287A only
3) Applies to 2286A only
4) Multiple A/Ds in 2286A system increase speed
5) Requires shunt resistor
6) Applies to 2285B only
7) 100 mV range available for thermocouple measurements and dc volts measurements when under computer control.
300 mV range is minimum front panel selectable range.

Introduction



Helios Plus offers 1000 channels/second in burst mode to accurately capture rapidly changing parameters.

The 2286A is programmed to monitor a power supply in a burn-in oven.

The Fluke Wireless Logger transmits data via spread spectrum wireless data link to a PC for analysis.

The Hydra Data Bucket can store periodic time-stamped data on its memory card as a part of a predictive maintenance program for production equipment.

Today, many companies are placing a greater emphasis on *quality*. For a company to remain competitive, quality must be built into their product or service. From evaluating a new product design through life testing, to production process monitoring and final test, Fluke data acquisition equipment helps manufacturers improve the quality of the products they provide to their customers.

Research and Development

Data acquisition equipment is useful in helping to improve products or processes. In R&D applications where testing requirements are often short-term and extremely varied, it is important that the equipment be easy to set up and configure to get the required results quickly. The compact Hydra Data Acquisition Series provides an interface that can be quickly adapted to the needs of a number of users, and its portability allows it to travel around the lab or in the field as required.

Design Testing

During product development, designs must be tested to ensure proper performance. The engineer or technician often measures various parameters on the bench or places the prototype in an environmental chamber to conduct reliability or life cycle tests. Small, portable data loggers capable of measuring a variety of parameters are an asset in this type of application. Because data analysis is most readily performed in a PC, all Fluke data acquisition instruments gather data in a PC-compatible format, enabling the user to analyze the results using spreadsheet or database programs.

Production Testing

There are several areas in the production environment that benefit from the use of data acquisition. An example of this is in the burn-in area of product testing. Here, data acquisition instruments gather measurement data while the product is being environmentally stressed. Manufacturers strive to discover any possible flaw in their product at the earliest possible moment, knowing it is far less expensive to find and change a faulty part at sub-assembly level, than to troubleshoot a finished product. Ultimately, their goal is to minimize failures in the hands of their customers.

Equipment Monitoring

Various machinery used throughout production areas needs to be monitored to prevent breakdown at an inopportune time. Data acquisition equipment is often used for "predictive maintenance." The maintenance staff monitors specific parameters on each machine on a regularly scheduled basis, then if measurement readings drift too far from the ideal, maintenance is scheduled for a time that causes the least impact on production. Data gathered in PC-compatible format can be used to analyze the results and look for trends.

Wireless Applications

New implementations of spread spectrum radio technology designed for secure military communications has given birth to a new category of data acquisition equipment - Wireless Data Loggers. The Fluke Wireless Logger allows users within any industry to setup remote test or monitoring sites on a moments notice and begin real time monitoring within minutes via a secure, noise immune wireless data link to a PC base station. The 2625A/WL Wireless Logger is a portable, easy-to-use wireless data acquisition tool that enables quick, immediate data collection and transmission to a PC from locations once considered too remote, inaccessible or environmentally hostile for real time monitoring systems. Each satellite accommodates up to 20 analog channels that can be set up within minutes and is ideally suited for PC-based data acquisition applications where quick, convenient setup is important.

Remote or Mobile Applications

There are many applications in remote areas, including in-vehicle testing that require data acquisition instruments operating in dc power. These types of instruments are designed to save the data in a PC-compatible format for analysis after the test is complete. In the case of gathering data in remote areas, the data acquisition equipment is often connected via modem to a computer at another site and data is transferred on regular intervals. Several Fluke data acquisition instruments support modem operation.

Application Software Completes the System

The Fluke family of data acquisition instruments addresses a wide variety of applications. To complete your system, we offer several PC-compatible application software packages which enable you to tailor the data acquisition system to your specific application.

Hydra Series

GPIB
IEEE-488

RS-232

NEW

2635A

2620A Hydra Data Acquisition Unit

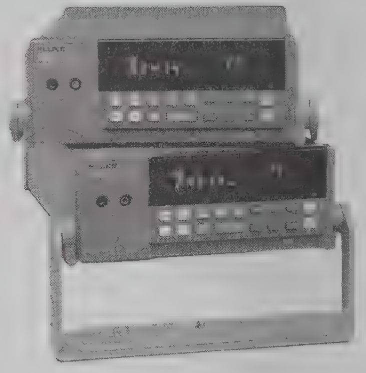
- 21 analog input channels
- Measures Vdc, Vac, thermocouples, RTDs, resistance, and frequency
- Standard RS-232C interface
- Optional GPIB IEEE-488 interface (2620A only)
- Easy set up through front panel or remotely via PC
- Application software for PC included: Hydra Starter Package
- Other available application software: Labtech Notebook™, Hydra Logger Package, and LabWindows (available from National Instruments)
- AC or DC operation enables Hydra to work where line power is not available

2625A Hydra Data Logger

- All the features of the Hydra 2620A, plus:
- Non-volatile data memory for mobile/remote monitoring (2047 scans)
- Supports operation with switch-selectable auto-answer modems

2635A Hydra Data Bucket

- All the features of the 2620A and 2625A, plus:
- Increased data memory capability using removable memory card
- Remote instrument set-up: you can load a stored configuration from the memory card
- Faster data transfer: using RS-232C (top speed of 38.4k baud) or by removing the memory card and using the memory card drive attached to your PC's parallel port



2620A & 2625A

The Hydra Series is available in three models to fit many application requirements. The 2620A Hydra Data Acquisition Unit is a compact front end for use with your PC. The portable 2625A Hydra Data Logger features non-volatile memory that stores more than 2000 scans, for stand-alone applications. And the 2635A Hydra Data Bucket with its removable memory card for data and set-up storage is the most versatile model – ideal for remote monitoring applications.

All models are easy to set up and reconfigure from the front panel. Additionally, all units have bi-directional communication via RS-232C, which enables control from a host computer. The RS-232C interface also supports stand-alone use with a serial printer. An optional GPIB/IEEE-488* interface is available for the 2620A only.

The Hydra Series is extremely rugged and able to operate in diverse environments. Its operating range is 0 to 60°C, and it is tested to stringent shock and vibration standards. Hydra's sturdy metal chassis effectively shields against electromagnetic interference, maintaining high measurement accuracy on low level signals. The analog circuitry is also isolated from the digital circuitry so you can measure high voltages directly (up to 300V ac rms). And it conforms to I.E.C. and CSA safety standards. What's more, all set-up information is battery-backed, so it's immune to power failure. Hydra will return from a power loss and resume scanning, while all configuration information and stored data remain intact.

Universal Input Module

The removable universal input module enables fast, convenient set-up and reconfiguration. Any combination of dc voltage, ac voltage, thermocouple, RTD, resistance, or frequency measurements can be connected to the input module

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**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

without the need for additional signal conditioning. Thermocouple reference junction compensation is automatically performed by sensing the temperature of the input module's isothermal block. For applications with multiple measurement locations, purchasing additional input modules provides the ability to quickly connect and disconnect a Hydra to these various sites while leaving all sensor wiring intact.

PC Operation

The Hydra 2620A Data Acquisition Unit provides a low-cost solution for PC-based applications requiring up to twenty analog inputs. Hydra can be connected in real time to your PC. Hydra's bi-directional RS-232C interface and computer command set provide complete remote control, duplicating all front panel functions. For IEEE-488 based systems, the 2620A/05 comes equipped with an IEEE-488 interface which duplicates the remote capabilities of the RS-232C interface.

Software Included

The **Hydra Starter Package** is included with the purchase of any Hydra instrument. Hydra Starter Package will run on any IBM® PC or compatible computer.

The Hydra Starter Package supports use of a single Hydra connected to a PC via RS-232C. Its menu-driven user interface makes it extremely easy to use. You configure Hydra from its front panel, connect it to the PC, then start your test. During operation, the Starter package displays readings of all channels in real-time and automatically logs the data to a Lotus 1-2-3® compatible file – select either ASCII or binary format. Additionally, when used with the 2625A or 2635A, the Starter package can retrieve the contents of the non-volatile data memory – again storing them in a 1-2-3 compatible ASCII file.

Software Available

The **Hydra Logger Package** is an optional software package that allows you to set up all channels and functions of one or two Hydras using your PC.

The Logger Package controls Hydra's scanning, collects data, graphs any eight channels in real-time, and creates a data file which may be directly imported into Lotus 1-2-3 or other spreadsheets for further analysis. All these capabilities are controlled via simple menus on your PC's display, either through a keyboard or mouse.

Versatility and fast set-up make **Labtech Notebook** an ideal data acquisition package for research applications. Flexible triggering and scanning and a comprehensive set of analysis tools make Notebook an excellent choice when your application calls for intensive mathematical analysis.

LabWindows (available from National Instruments) gives you a complete IEEE-488 program development environment that's fast and easy to use due to its function panels. It allows you to program in QuickBASIC™ or "C". Just fill in function panels for complete instrument control and ready-to-use graphics and analysis capabilities. In addition, there are drivers for many other instruments. See the Application Software section on page 212 for more details.

Printer Operation

For stand-alone use without a PC, the print function in all Hydra models controls the data flow to a local printer. Autoprint has three operating modes: print all data; print all data if any channel is in alarm; or print all data if any channel has transitioned into or out of alarm. The 2625A Hydra Data Logger and the 2635A Data Bucket are also able to store and print data simultaneously, thereby allowing you to access the data later for further analysis on your PC.

Data Logger Operation

The Hydra 2625A Data Logger is differentiated by its built-in non-volatile recording capability. This feature makes data capture and offline storage very flexible and convenient. The memory holds 2047 sets of readings on each of the 21 analog input, 12 digital I/O, and totalizer channels – enough to hold one scan per minute for more than 24 hours. The Hydra Data Logger is ideal for recording data during environmental stress screening, thermal testing, design testing, and other applications that require data logger with up to twenty analog measurement channels.

External Disk Drive

Another possibility to store data is to use the 262XA-802 External Disk Drive. By connecting it to Hydra's serial output (2620A and 2625A), up to 325,000 readings can be stored on a high density 3$^1/_2$" diskette.

Remote Operation

The 2635A Hydra Data Bucket has been designed for applications where data is gathered in a stand-alone manner "on location" and later uploaded to a PC for analysis and/or archiving. The Data Bucket is equipped with a removable, 256K byte memory card (it will accommodate up to a 2M byte memory card). Up to 450,000 readings may be stored on a 2M byte memory card. For applications where large amounts of data are generated, you may swap memory cards without interrupting the Data Bucket's scanning.

The memory cards also store 2635A instrument configurations, enabling remote programming. For example, you could establish the desired Hydra configuration using Hydra Logger software package, load it onto a memory card, and then send it to the 2635A site, where it could be downloaded using a few front panel keystrokes. After completion of the data acquisition "run", the memory card would be returned for uploading the data into a PC.

Data Bucket is ideal for monitoring in mobile or remote applications such as weather stations, tank farms, or power substations, to verify that site equipment is set up and performing properly. All data can also be retrieved via modem, or you can request just the minimum, maximum, or last reading from each channel.

Memory Card Drive

The Memory Card Drive provides an easy way to transfer your data from the Data Bucket's memory card to a PC. It may also be used to download your latest Data Bucket set-up to the memory card for later use in the field.

Housed in a compact, durable metal enclosure, the Memory Card Drive has robust data communication protocol to ensure accurate data transmission. An MS-DOS device driver allows the unit to work like a floppy disk. The Memory Card Drive supports cards from major manufacturers such as: Epson, Fujikura, Fujitsu, Maxell, and Mitsubishi. Just connect the reader to the parallel interface port of your PC, then use either Hydra Starter or Logger software packages to upload or download Hydra data or set-up files.

Specifications

Channel Capacity: Analog Inputs: 21; Digital I/O & Alarm Outputs: 12 total; Totalizer: 1

Power: 90V ac to 264V ac (50 Hz or 60 Hz), or 9V dc to 16V dc; less than 10W. (If both sources are applied simultaneously, the greater of ac or dc is used. At 120V ac the equivalent dc voltage is ~14.5V)

Temperature, Humidity (non-condensing)**:** Operating: 0 to 28°C, ≤90% RH; 28°C to 40°C, ≤75% RH; 40°C to 60°C, ≤50% RH; Storage: -40°C to 75°C, 5 to 95% RH

Altitude: Operating: 3050m (10,000 ft); Storage: 12,200m (40,000 ft)

Common Mode and Normal Mode Voltage Maximum: 300V dc or ac rms (channels 0,1,11); 150V dc or ac rms (all other channels)

Isolation: Analog input to analog input, and analog input to any digital input: meets IEC 1010 for 300/150 volts reinforced and ANSI/ISA-S82.01-1988 and CSA 231for 250 volts single insulation

Safety: Complies with applicable sections of the IEC1010, ANSI/ISA-S82.01-1988, CSA231, UL 1244, and CSA 556B standards as noted above in Isolation

RF Emissions: Passes FCC EMI Class A Equipment and VDE 0871B

Size: 9.3 cm H x 21.59 cm W x 31.19 cm D (3.67 in H x 8.5 in W x 12.28 in D)

Weight: 2.95 kg (6.5 lb)

Memory life: 10 years typical for real-time clock, set-up configuration and measurement data in 2625A, memory cards typically 5 years for the 256 kB card.

Measurement Accuracy

DC Voltage			Accuracy^{1} ± (% + V)		
Range	Resolution		Slow Scan		Fast Scan
	Slow	Fast	90 days	1 year	1 year
300 mV	10 µV	100 µV	0.03% + 20 µV	0.03% + 20 µV	0.05% + 0.2 mV
3V	100 µV	1 mV	0.03% + 0.2 mV	0.03% + 0.2 mV	0.05% + 2 mV
30V	1 mV	10 mV	0.02% + 2 mV	0.03% + 2 mV	0.05% + 20 mV
300/150V	10 mV	100 mV	0.02% + 20 mV	0.03% + 20 mV	0.04% + 0.2V
Resistance			**Accuracy (4 wire)^{1,3} ± (% + Ω)**		
300Ω	10 mΩ	100 mΩ	0.06% + 20 mΩ	0.06% + 20 mΩ	0.06% + 200 mΩ
3 kΩ	100 mΩ	1Ω	0.05% + 0.2Ω	0.06% + 0.2Ω	0.06% + 2Ω
30 kΩ	1Ω	10Ω	0.06% + 2Ω	0.06% + 2Ω	0.06% + 20Ω
300 kΩ	10Ω	100Ω	0.05% + 20Ω	0.06% + 20Ω	0.06% + 0.2 kΩ
3 MΩ	100Ω	1 kΩ	0.06% + 0.2 kΩ	0.06% + 0.2 kΩ	0.06% + 2 kΩ
10 MΩ	1 kΩ	10 kΩ	0.12% + 2 kΩ	0.12% + 2 kΩ	0.20% + 30 kΩ
AC Voltage (True rms, ac coupled)			**Frequency**	**Accuracy^{1,2} ± (% + counts)**	
300 mV 3V 30V 300/150V	10 µV 100 µV 1 mV 10 mV	100 µV 1 mV 10 mV 100 mV	20 Hz - 50 Hz	3.0% + 15	4.0% + 3
			50 Hz - 150 Hz	0.3% + 15	0.3% + 3
			150 Hz - 10 kHz	0.2% + 15	0.2% + 3
			10 kHz - 20 kHz	0.4% + 15	0.4% + 3
			20 kHz - 50 kHz	2.0% + 20	2.0% + 4
			50 kHz - 100 kHz	5.0% + 50	5.0% + 10

Thermocouples^{6}		Accuracy^{1,5} (±°C)				
		Operate 18°C to 28°C			0°C to 60°C	
Type	Sensor Temperature (°C)	90 Day Slow	1 Year Slow	1 Year Fast	1 Year Slow	1 Year Fast
J	-100 to -30	0.46	0.47	0.89	0.56	1.07
	-30 to 150	0.41	0.43	0.80	0.59	1.02
	150 to 760	0.51	0.56	0.98	0.92	1.39
K	-100 to -25	0.54	0.55	1.09	0.65	1.28
	-25 to 120	0.47	0.49	0.94	0.65	1.16
	120 to 1000	0.77	0.83	1.49	1.37	2.10
	1000 to 1372	1.19	1.28	2.11	2.06	2.97
N	-100 to -25	0.67	0.68	1.41	0.77	1.59
	-25 to 120	0.58	0.60	1.21	0.70	1.39
	120 to 410	0.54	0.55	1.10	0.78	1.32
	410 to 1300	0.82	0.89	1.59	1.50	2.25
E	-100 to -25	0.47	0.48	0.89	0.58	1.07
	-25 to 350	0.41	0.42	0.76	0.63	0.99
	350 to 650	0.48	0.52	0.88	0.84	1.26
	650 to 1000	0.62	0.68	1.14	1.17	1.69
T	-150 to 0	0.73	0.74	1.47	0.84	1.69
	0 to 120	0.48	0.49	0.94	0.60	1.11
	120 to 400	0.41	0.43	0.80	0.64	1.03
R	250 to 400	1.04	1.06	2.56	1.20	2.74
	400 to 1000	0.98	1.00	2.38	1.34	2.56
	1000 to 1767	1.21	1.30	2.71	2.01	3.45
S	250 to 1000	1.08	1.10	2.68	1.46	2.87
	1000 to 1400	1.10	1.17	2.53	1.68	3.07
	1400 to 1767	1.37	1.47	3.10	2.22	3.88
B	600 to 1200	1.31	1.32	3.56	1.53	3.78
	1200 to 1550	0.91	0.94	2.24	1.35	2.65
	1550 to 1820	1.00	1.06	2.44	1.59	2.98
C	0 to 150	0.90	0.92	2.00	1.06	2.21
	150 to 650	0.77	0.81	1.69	1.15	2.05
	650 to 1000	0.92	0.98	1.97	1.49	2.52
	1000 to 1800	1.50	1.63	3.15	2.69	4.28
	1800 to 2316	2.52	2.75	5.14	4.56	7.05

Interfaces: RS-232C connector: nine pin male (DB-9P)
signals: TX, RX, DTR, GND
modem control: Full duplex
baud rate:* 300, 600, 1200, 2400, 4800, 9600, 19.2k**, 38.4**
data format: 8 data bits, no parity, one stop bit; or 7 data bits, one parity bit (odd or even), one stop bit
echo:* On/Off
flow control: XON/XOFF

** Set from front panel*
*** 2635A only*

IEEE-488 (Optional, 2620A Only): Complies with IEEE-488.1 Standard; disables RS-232C Interface while in use

2625A Data Storage: Stores 2047 scans; stored with each scan: time stamp, all defined analog input channels, the status of four alarm outputs and eight digital I/O, and the totalizer count

2635A Data Storage (in scans)
(same information as 2625A)

Card Size	4 ch	10 ch	20 ch
256k	8900	4800	2700
1M	36500	19800	11200

RTD (Pt 100)	Resolution		Accuracy^{1,4} (±°C) (4 wire)	
Temp (°C)	Slow	Fast	Slow	Fast
-200	0.02	0.1	0.08	0.49
0	0.02	0.1	0.21	0.67
100	0.02	0.1	0.27	0.75
300	0.02	0.1	0.41	0.92
600	0.02	0.1	0.65	1.21

[1] Total instrument accuracy for 1 year following calibration (unless otherwise stated). Ambient operating temperature 18°C to 28°C. Includes A/D errors, linearization conformity, initial calibration error, isothermality errors, and reference junction conformity. (Sensor inaccuracies not included.) Relative humidity up to 90% non-condensing (except up to 70% for the 300kΩ, 3MΩ, and 10MΩ ranges).

[2] Sinewave inputs >2000 counts

[3] For two wire measurements on channels 1-20, add 1.5Ω to basic accuracy (does not include lead-wire resistances).

[4] DIN 385 only, assumes no lead wire resistance errors. Degrade accuracy for 2 wire sensors with R_o = 100Ω by 5.0°C per lead-ohm, plus an additional 4°C for 2 wire measurements on channels 1 - 20.

[5] Resolution is 0.1°C or 0.1°F over the useful range of base metal thermocouples (J, K, T, E, N) and 0.2° resolution for types R, S, B, and C, with slow scan. Fast scan resolution = 1°C or F.

[6] Open thermocouple detection is performed on each thermocouple channel unless defeated by computer command.

Frequency

Range	Resolution		Accuracy*
	Slow	Fast	±(% + counts)
15 Hz - 1kHz	0.01 Hz	0.1 Hz	0.05% + 2
10 kHz	0.1 Hz	1.0 Hz	0.05% + 1
100 kHz	1 Hz	10 Hz	0.05% + 1
1000 kHz	10 Hz	100 Hz	0.05% + 1
1 MHz	100 Hz	1 kHz	0.05% + 1

Sensitivity

Frequency	Level
15 Hz - 100 kHz	100 mV rms sine wave
100 kHz - 300 kHz	150 mV rms sine wave
300 kHz - 1 MHz	2V rms sine wave
Above 1 MHz	not specified

**Accuracy for both slow and fast scan speeds.*

Current Measurements

AC or dc current measurements may be accomplished using either a current shunt or external current probes. Using Mx+B scaling provides direct readings in amps. For lower current levels, shunts may be located in the input module. Suggested shunt values:

Input	Shunt
0 to 100 mA	10 Ω
100 mA to 1A	0.1 Ω

For higher currents, the following current probes are recommended:

1A to 1000A dc	80i-1010 Probe
20A to 750A ac	80i-1010 Probe
20A to 400A ac/dc	80i-410 Probe

Alternatively, to measure 1.0 to 10.0A on Hydra's front panel input, use the 80J-10 Current Shunt

Common Mode Rejection: (slow scan) ac: ≥120 dB (50/60 Hz, ±0.1% max 1 kΩ source imbalance); dc: ≥120 dB
Normal Mode Rejection: (slow scan) 56 dB (50/60 Hz, ±0.1%)
Temperature Coefficient: <0.1 times applicable accuracy specification per °C for 0° to 18° and 28° to 60°C operation
Scan Speed: Slow: 4 rdg/sec nominal; fast: 17 rdg/second nominal, (1.5 rdg/sec for ACV and high Ω inputs nominal)
Analog to Digital Converter: Dual slope type, linear to 16 bits

Totalizing Input

DC-coupled, non-isolated, max +30V, -4V
Max Count: 65,535
Minimum Signal: 2V peak
Threshold: 1.4V
Hysteresis: 500 mV
Rate: 0-5 kHz (debounce off)
Input Debouncing: None or 1.66 ms

Digital Inputs

Threshold: 1.4V
Hysteresis: 500 mV
Maximum Input: +30V, -4V, non-Isolated

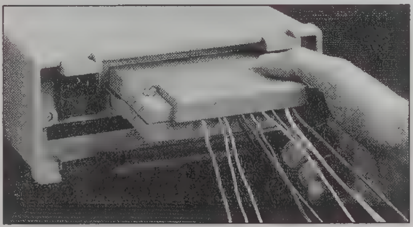
Digital Alarm Output

The output lines are non-isolated, TTL compatible with the following logic levels (driving the equivalent of 1 LSTTL load):
Logical "zero" output: 0.8V max, (I_{out} = -1.0 mA)
Logical "one" output: 3.8V min, (I_{out} = 0.05 mA)

For non-TTL loads, the outputs are as follows:
Logical "zero" output: 1.8V max, (I_{out} = -20 mA)
3.25V max, (I_{out} = -50 mA)

Trigger Input

Minimum Pulse: 5 µs
Maximum Latency: 100 ms
Repeatability: 1 ms
Input "High": 2.0V min, 7.0V max
Input "Low": -0.6V min, 0.8V max, non-isolated, contact closure and TTL compatible
Clock/Calendar: Accurate to within 1 minute/month at 25°C



Accommodating 20 channels of nearly any input type, Hydra's Universal Input Module is easily removed to access field wiring.

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QuickBASIC is a trademark of Microsoft Corporation.
Labtech ACQUIRE and Labtech Notebook are trademarks of Laboratory Technologies Corporation.
Lotus 1-2-3 and Lotus Symphony are trademarks of Lotus Development Corporation.
IBM is a registered trademark of International Business Machines Corporation.
Windows is a registered trademark of Microsoft Corporation.

Ordering Information

Models

2620A Hydra Data Acquisition Unit
2620A/05 Hydra Data Acquisition Unit w/IEEE-488 Interface
2625A Hydra Data Logger
2635A Hydra Data Bucket

Included with Instrument
One-year product warranty, line cord, Universal Input Module, Hydra Starter Software Package, 256K memory (2635A only), T thermocouple, and operator's manual.

Options
2620A-100 Extra I/O Connector Set: Includes Universal Input Module, Digital I/O and Alarm Output Connectors
2620A-05K IEEE-488 Interface Kit (2620A only)
262XA-801 Diconix 80-Column Serial Printer
263XA-802* External Disk Drive
263XA-803 Memory Card Drive
263XA-804 256 KB Memory Card
263XA-805 1 MB Memory Card

Application Software
262XA-901 Hydra Data Logger Package
262XA-910* ScanScope Software Package for Windows 3.X
S2290 LabTech Notebook
S2291* LabTech Control
S2292* LabTech Notebook/XE
**Available in European countries only*

Accessories (Also see Section 19)
RS40 RS-232C to Terminal Cable: Connects to PC/XT, PS/2
RS41 RS-232C to Modem Cable (Join w/RS40 to connect to PC/AT)
RS42 RS-232C to Printer Cable (for 262XA-801 & serial printers)
80i-410 Clamp-on DC/AC Current Probe
80i-1010 Clamp-on DC/AC Current Probe
80J-10 Current Shunt
C40 Carrying Case
M00-200-634 Rack Mount Kit
Y8021 Shielded IEEE-488 Cable, 1m
Y8022 Shielded IEEE-488 Cable, 2m
Y8023 Shielded IEEE-488 Cable, 4m

Manuals
2620A/2625A Reference Card
2620A/2625A Service
2620A/2625A Software
2620A/2625A User
2620A/2625A* User Set
2620A/2625A Labtech Starter Application
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

NEW

2625A/WL

New! Fluke Wireless Logger

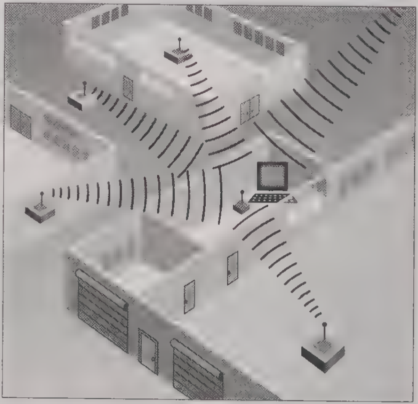
Signaling a New Era in Data Acquisition

The 2625A/WL Wireless Logger is a new class of data acquisition tool that uses a highly noise immune radio transmission technique, instead of wire and cables, to transmit real time data to a host computer up to 1/4 mile away! The new Wireless Logger gives you the freedom to setup and operate on a moment's notice, anywhere, anytime without dealing with expensive and inconvenient wiring to a host PC. Each Wireless logger can accommodate up to 21 analog inputs of any type and up to 20 Wireless Loggers can operate from one base station PC, giving you expandable, wireless operation. The 2625A/WL is Ideally suited for real time, PC-based data acquisition applications where quick, convenient setup in difficult or hostile areas is important.

Spread Spectrum

The key to the Wireless Logger system is its use of spread spectrum radio transmission, a highly noise immune form of communication. Spread spectrum technology was originally developed for the military to provide secure , non-jammable communications for intelligence ,command, and tactical groups as well as guidance and delivery systems. The 2625A/WL Fluke Wireless Logger uses this same technology to reliably send data directly to your PC with a high degree of immunity to electrical noise and interference. Almost impervious to RF interference the 2625A/WL is well suited for real time data collection from remote or otherwise difficult-to-access areas.

Spread spectrum technology allows the wireless Logger to transmit successfully in electrically noisy areas where narrow band transmitting equipment, and even some hard-wired systems fail. This means that motors, solenoids, walkie-talkies, induction heaters and other sources of sever electrical interference have almost zero chance of interrupting your data. Another benefit of the Wireless Logger is its ability to coexist with other electronic equipment. Its low 500 mW power output is lower than many cellular phones. The spread spectrum modulation technique spreads a small signal over a wide bandwidth and peak power at any frequency is around 30 db lower than an equivalent narrow band transmission. This lower energy content of the spread spectrum signal means it won't disrupt or interfere with other electronic instrumentation. Because the Wireless Logger's output is less than one watt and it uses non-intrusive spread spectrum signals, it complies with FCC part 15C and does not require an FCC site license.



Now you can have multiple satellites transmitting data to a central PC from various locations throughout your plant without incurring wiring installation costs.

Wireless Logger System

The Wireless Logger system may consist of up to twenty (20) Wireless Loggers (2625A/WL), communicating to one (1) Wireless Base station (26X5A/WL-700) each base station includes Wireless Logger for Windows application software and a wireless base station modem. The familiar windows format of Wireless Logger for Windows makes initial instrument setup, data collection, creating real time trend graphs and other data acquisition tasks easy and intuitive from your PC.

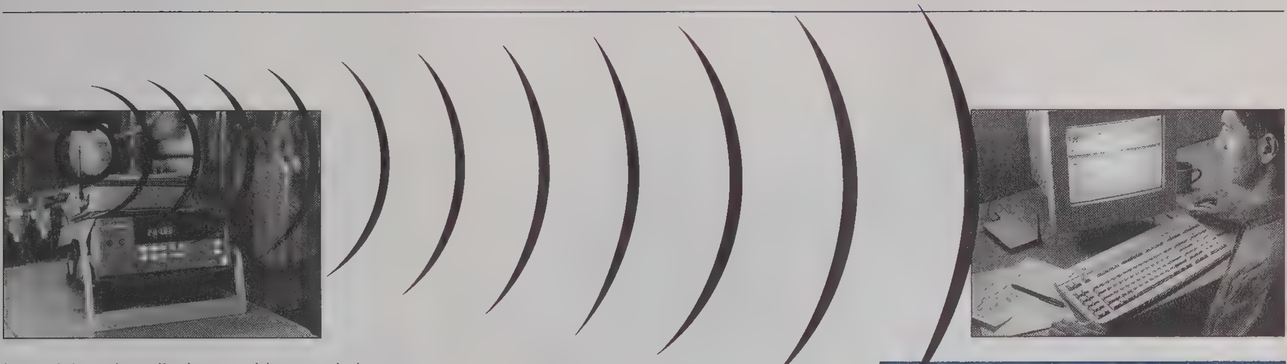
Wireless Logger (2625A/WL)

The light weight and portable Wireless Logger data acquisition tool is easy to setup and operate. The 2625A/WL is flexible, rugged and accurate and has all the outstanding features and specifications of the Hydra 2625A (see page 195 for 2625A specifications). Simply connect your inputs to the universal input connector on the wireless logger, run Wireless Logger for Windows application software on your PC, and you are operating in real time, remotely, with no wiring obstacles to overcome and no external signal conditioning to hook up.

Wireless Logger for Windows

Wireless Logger for Windows is a true windows based data acquisition software package specifically for use with the 2625A/WL Wireless Logger. Wireless Logger for Windows supports scanning, channel definition, trend graph analysis,and alarm configurations for up to 20 Wireless Loggers in one host PC. The familiar Windows based format of Wireless Logger for Windows makes data collection and instrument setup an easy, intuitive task. In addition to its trend graph display, Wireless Logger for Windows also allows the user to port data in real time, directly to other programs such as Lotus 1,2,3, and Excel by using a DDE (Dynamic Data Exchange) link. With Dynamic Data Exchange you can share data in real time with other windows programs like Microsoft Excel, Lotus 1-2-3 , and In Touch by WonderWare.

Wireless Logger



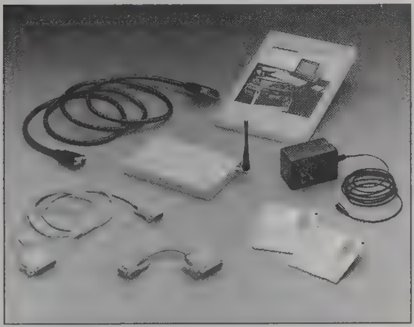
Its real time data display provides trend plots as events are occurring. And you can transfer data between programs for report generation. Wireless Logger for Windows will also support a 2625A or 2635A connected to a PC's RS-232C port in addition to communicating to Wireless Logger Satellites.

With Windows multi-tasking, you can be working with a word processor in one window, a spread sheet in another and monitoring your Wireless Logger in another. You can also set an alarm to alert you to pre-determined events regardless of which program you're in.

Fault Tolerant

Wireless Logger stores over 2000 scans in its non-volatile buffer. That's especially important if you're performing a test that's difficult or expensive to reproduce.

If, for any reason, your PC goes down or needs to be re-booted, Wireless Logger satellites will continue to collect measurements and store over 2000 scans in each satellite. When your PC comes back on line, your data will be transferred to your data file, automatically, thus saving you from frustration as well as extra time and expense due to loss of data.

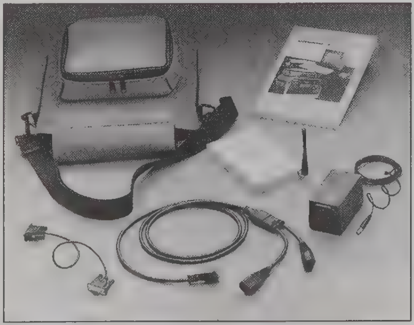


2625A/WL-700

Applications

Typical applications for the Wireless Logger include process improvement diagnostics, preventative maintenance profiling, new product testing, laboratory tests, vehicle testing and other applications where fast and immediate setup and real time monitoring are required.

The Wireless Logger excels in applications were immediate information is needed to verify a process or situation. Plant engineering and maintenance, process industries, power generation, and vehicle testing are just a few representative areas where applications for the Wireless Logger and Wireless Logger for Windows package can cut otherwise large cumbersome jobs into small ones. The Wireless Loggers ability to transmit through barriers such as walls and floors and to transmit up to 800 feet indoors and 1/4 mile in line-of-sight applications is key to getting your data when and where you want it.



26X5A/WL-701

Ordering Information

Model

2625A/WL Fluke Wireless Logger

26X5A/WL-700 Wireless Base Package: includes Wireless Modem, Wireless Logger for Windows S/W Package, Hydra Wireless Logger, User Manual, RS40 Cable, DB25 to DB9 Adapter

Included with Instrument

2625A Hydra Data Logger, Wireless Modem, Getting Started Manual, Soft Carrying Case for the Wireless Logger, Wireless Logger Power Kit.

Options

26X5/WL-701 Hydra Wireless Conversion Kit; for converting models 2625A or 2635A to a wireless logger: includes Wireless Modem, Soft Carrying Case for the Wireless Logger, Getting Started Manual, Wireless Logger Power Kit

26X5A/WL-702 Wireless Modem

26X5A/WL-703 Wireless Logger Power Kit: includes Power Module, Receptacle Power Cable, Short RS-232C Cable

26X5A/WL-902 Wireless Logger for Windows S/W Package, Windows-based Software Program, Wireless How To Manual

2620A-100 Extra I/O Connector Set: includes Universal Input Module, Digital I/O and Alarm Output Connectors

26XXA-600 Hydra Portable Battery Pack (available fall 1993)

Accessories

C42 Wireless Logger Soft Carrying Case

PV350 Pressure/Vacuum Transducer Module

80i-410 Clamp-on DC/AC Current Probe

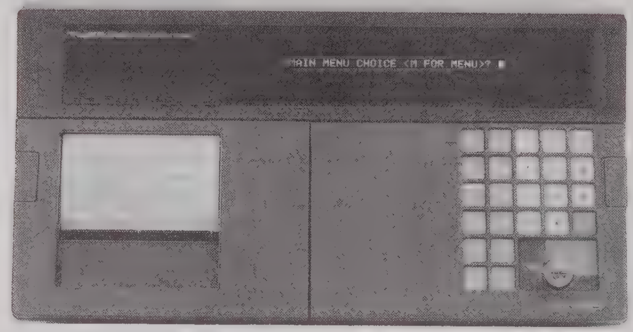
80i-1010 Clamp-on DC/AC Current Probe

80J-10 Current Shunt

2280 Series

GPIB
IEEE-488

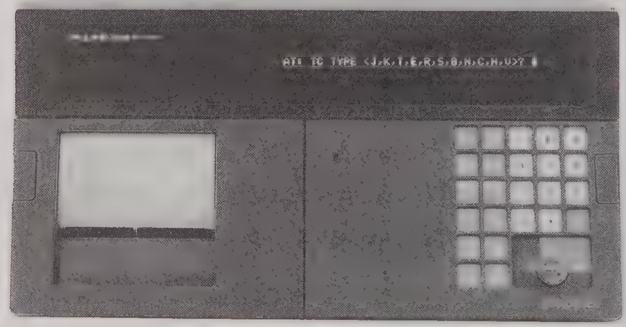
RS-232



(NSN 6625-01-320-1546) **2286A**

2286A Data Logging System

- Fluke's most powerful stand-alone data logger
- Expandable to 1500 channels*
- Precision measurements on a wide variety of input types
- 3.5" floppy drive, MS-DOS compatible
- 12V operation for mobile or field use
- Pseudo-channels provide computing power without writing software



2285B

2285B Data Logger

- Economical solution for simpler applications
- Expandable to 100 channels
- Precision measurements on a wide variety of input types
- Flexible report generation
- 12V operation for mobile or field use
- Pseudo-channels give computer power without writing software

The 2280 SERIES family of data loggers combines high measurement accuracy, exceptional configuration flexibility, and computer-like power without requiring the user to write software. This family, composed of the 2285B Data Logger and the more powerful 2286A Data Logging System, offers solutions for demanding data acquisition and reporting problems.

The 2286A Data Logging System, Fluke's most powerful data logger, features an MS-DOS compatible microfloppy drive for data and program storage. The disk can be taken from the 2286A, inserted directly into a PC, and the data files (stored in DIF format) imported into Lotus 1-2-3™ or other spreadsheets. The 2286A is expandable from a simple 20-channel data logger to a distributed 1500-point data acquisition system.

For applications that do not require all the power or expansion capabilities of the 2286A Data Logging System, the 2285B Data Logger is a more economical solution. Expandable up to 100 channels, the 2285B accepts most 228X I/O options except the Analog Output (-170), Counter/Totalizer (-167) and Math Coprocessor (-211) options.

Programming Ease

Both the 2285B and 2286A are programmed by responding to a series of prompted menus. Simple front panel responses to the displayed questions configure the 2280 SERIES to perform the required tasks. Instead of limiting the user to predefined functions, or requiring the development of libraries of application software, the 2280 SERIES employs pseudo-channels. An exclusive 2280 SERIES feature, pseudo-channels allow any mathematical relationship between channels, such as group averages; or between a channel and time, such as rate of change; to be described as a simple algebraic equation. With pseudo-channels, application problems that previously required the power of a computer, and an investment in software, are now possible in a stand-alone data logger.

Power to Get the Job Done

Complementing this computational power, the 2280 SERIES offers excellent documentation features. Each measurement channel, output channel or pseudo-channel can be uniquely identified with a 15-character label, clearly describing the point being logged. Adding further clarity, 6-character, user defined, engineering units for each point are a standard feature. Also standard is the ability to check every input, output or pseudo-channel against alarm limits. Four high/low limits are available for each channel, and each limit can cause a user defined 40 character message describing the alarm condition to be recorded.

**Depending on programming requirements.*

Report Generation

The 2280 SERIES allows its recording function to be easily tailored to the requirements of the job. Collected data, the results of calculations, or outputs can be viewed on the bright, 40-column vacuum fluorescent display, or logged on the wide format 40-column internal printer. Adding further recording flexibility are two communication ports which can be configured with optional RS-232C or GPIB/IEEE-488* interfaces. A 3.5" floppy drive is a standard feature of the 2286A. The MS-DOS compatible drive allows the user to save data on a disk and be able to insert that disk directly into the PC for data manipulation. Both programs and data can be stored on a disk.

For Demanding Environments

Applications that require more input or output points than can be housed in the mainframe are satisfied by using the 2281A Extender Chassis. These extender chassis are connected to the mainframe with a simple six twisted pair cable, and communicate via a high speed, fault tolerant, communication network. Since all communication is digital, signal integrity is assured in electrically noisy environments. Furthermore, any input or output options housed in an extender chassis have an operating range of -20°C to +70°C.

Portable Operation

Another standard feature is full operation from 12V dc power, making the 2280 SERIES a natural for mobile data acquisition. Additionally, connecting a 12V battery allows this dc operating mode to function as an uninterruptable power supply. The 2280 SERIES trickle charges the battery when on line power and bumplessly transfers to battery operation when line power fails, assuring measurement integrity for critical applications.

2280 SERIES I/O Options

2280 SERIES mainframes and extender chassis use a "card cage" architecture that provides superior configurability because both channel count and type may be easily adjusted to match your application needs. If a new I/O type is needed, just slide the appropriate option and connector in the next open slot and secure with two captive screws.

The "card cage" architecture provides six slots per mainframe or extender chassis for I/O options. When analog input options are included, one of the six slots must contain an A-to-D converter (2280-161). The -161 A-to-D converter controls one to five 20-channel "scanner" options for up to 100 channels per mainframe or extender chassis. Digital input options each handle 20 channels for up to 120 channels per mainframe or extender (2285B, only 100 channels total). Total system capacity for the 2286A is as high as 1500 channels when extender chassis are used.

Information on the 228X I/O options is found on page 209 of this catalog.

Specifications

2280 SERIES System

Maximum Inputs & Outputs: ≤1500 channels per system (2286A) using 2281A Extender Chassis; ≤100 channels per system (2285B)
Analog Inputs: ≤1500 channels per system (2286A), ≤100 channels per system (2285B)
Status, Binary, or BCD Inputs: ≤1500 channels per system (2286A), ≤100 channels per system (2285B)
Status Outputs: ≤1500 channels per system (2286A); ≤100 channels per system (2285B)
Alarm Outputs: ≤1500 channels per system (2286A); ≤100 channels per system (2285B)
Analog Outputs: ≤600 channels per system (2286A only)
Computation Power: Besides built-in thermocouple and RTD linearizations, the 2280 SERIES will handle equations involving addition, subtraction, multiplication, division, and parentheses. Math Coprocessor Option (-211) (2286A only) adds square root, exponent, logarithm, trigonometric, standard deviation, interpolation tables, logic functions, equal-to, less-than, great-er-than, etc.
Tasks: Up to 10 independent, prioritized scan groups
Scanning Speed: Depends on the number of A-to-D Converter Options (-161) per system and the system configuration. Scanning dc voltage inputs for alarms at full accuracy:
Up to **16** channels per second with **1** A/D
Up to **30** channels per second with **2** A/Ds
Up to **42** channels per second with **3** A/Ds
Up to **65** channels per second with **5** A/Ds
Temperature: 0°C to 50°C operating (2286A/2285B); -20°C to 70°C operating (2281A)
System Communications: High speed digital data transferred between 2281As and a 2286A/2285B is via noise-immune twisted wire-pairs; may be linked in star and/or daisy-chain configurations.
Distance To Extender Chassis: Any 2281A may be up to 1 km away from a 2286A/2285B
Failures: System component failures are reported as an alarm. All properly operating equipment continues with normal tasks.
I/O Capacity: Six slots for input and output options. One of the six slots must contain an A-to-D converter option when one or more analog input options are used. Each analog input option will scan 20 channels and each status or digital input or output option will handle 20 lines. If no A-to-D converter option is needed the 2286A will handle up to 120 points of status inputs or outputs. Two additional plug-in slots are for any combination of one or two IEEE-488 or RS-232 options.
Program Memory: 32K bytes (2286A); 20K bytes (2285B). Non-volatile. Battery back-up for at least 30 days, 90 days typical. Program may also be printed using internal printer or with optional interface to external devices.
Internal 3.5" Disk Drive: MS-DOS compatible disk drive used to store both data and programs. User can select high or low density disk format. The data can be stored in DIF or ASCII text format. Four compression formats are selectable for recorded data. Storage capacity is up to 150,000 channel readings dependent upon disk density, data format and number of channels in a scan group. The data stored on disk may be transferred to the internal printer, peripheral devices or the disk may be placed directly into a 3.5" drive attached to a PC and read. One blank micro-floppy is included with the 2286A.
Internal Printer: Uses thermosensitive paper, 110 mm (4.4 in) wide. Up to 40 alphanumeric characters per line printed from 5x7 dot matrix, 2.6 lines per cm (6.7 lines per in). Each line printed below the previous line. Will plot one to four graphs from scanned or calculated data, instead of alphanumeric characters, using distinctive symbol for each graph in any of 276 discrete positions across width of paper. Automatic paper take-up reel prevents spilling and allows withdrawal of any printed portion for review.
Power: 100, 120, 220, or 240V ac ±10%, 50 or 60 Hz. Or 10.5 to 15V dc. AC power will trickle-charge 12V battery for uninterrupted power. Less than 120W fully loaded.
Size: 22.23 cm H x 43.94 cm W x 66.17 cm L (9.35 in H x 17.30 in W x 26.05 in L)
Weight: 20-29 kg (45-66 lb) depending on configuration

DC Voltage Accuracy: ±(% of Rdg + Counts)*

Range	90 Days 15°C°C to 35°C	1 Year 15°C to 35°C	1 Year** -20°C to 70°C
±64 mV	0.005% + 7	0.01% + 8	0.03% + 9
±512 mV	0.005% + 3	0.01% + 4	0.03% + 5
±8V	0.005% + 7	0.01% + 8	0.03% + 9
±64V	0.009% + 3	0.02% + 4	0.05% + 5

**Total instrument accuracy using Option -162 and -176*
***A/D Converter must be in 2281A for operation to -20°C or 70°C*

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

2280 Series

Temperature Measurement Accuracy

Thermocouples		Accuracy [1] [3]		
Type & Range (°C)	Temperature (°C)	90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year[2] -20°C to 70°C
J	-100 to +200	0.35	0.4	0.9
-200 to 760	+200 to +760	0.45	0.5	0.76
K	-100 to +200	0.35	0.4	1.0
-275 to 1350	+200 to 1350	0.5	0.6	1.25
T	-100 to +200	0.35	0.4	1.0
-230 to 400	+200 to +400	0.45	0.5	0.6
E	-100 to +250	0.35	0.4	0.9
-250 to 900	+250 to +838	0.45	0.6	0.85
N [4]	-100 to 150	0.6	0.7	1.1
-200 to 400	150 to 400	0.4	0.44	0.7
R	0 to +200	1.15	1.35	2.2
0 to 1767	+200 to +1767	0.95	1.15	1.6
S	200 to 1767	0.97	1.1	1.6
0 to 1767				
B	600 to 800	1.4	1.6	1.9
200 to 1820	800 to 1820	0.96	1.1	1.3
C	200 to 1000	0.57	0.66	0.94
0 to 2315	1000 to 2000	0.90	1.2	2.1
	2000 to 2315	1.3	1.7	2.9
JDIN	-100 to +200	0.35	0.4	0.9
-200 to 900	+200 to +900	0.45	0.5	0.75
TDIN	0 to 200	0.48	0.53	0.8
-200 to 600	200 to 600	0.37	0.41	0.7

[1] *Total instrument accuracy. Includes all instrument errors such as A/D errors, scanner errors, power supply warm-up, reference junction errors, conformity errors, etc.*

[2] *Total instrument accuracy using Option -162 and -175 in 2281A chassis.*

[3] *A/D Converter must be in 2281A for operation to -20°C or 70°C.*

[4] *For AWG 28 wire.*

RTD Measurement Accuracy (using -164, -174 options)

RTD Type & Range	Maximum Instrument Error*
100Ω Platinum RTDs	
-200°C to +200°C	0.1°C
200°C to 600°C	0.15°C
10Ω Copper RTDs	
-75°C to +150°C	1.0°C

**Total Instrument Accuracy, 13°C to 33°C for 90 days.*

Repeatability: ±0.08°C for Platinum RTDs, ±0.2°C for Copper RTDs
Temperature Coefficient: ±10 ppm/°C

RTD Specifications, Six Classes (-163, -177)

A–User-defined high resolution Platinum RTDs
B–High resolution Platinum 385 DIN RTDs
C–User-defined high temperature Platinum RTDs
D–High temperature Platinum 385 DIN RTDs
E–Ten ohm Copper RTDs, not grounded, electrically insulated
F–Ten ohm Copper RTDs, grounded (special, consult factory)

RTD Class	Temperature	System		
		Resolution	Accuracy*	Repeatability*
A	-200 to +150°C	0.006°C	0.1°C**	0.04°C**
	+150 to +420°C	0.006°C	0.15°C**	0.04°C**
B	-200 to +150°C	0.006°C	0.10°C**	0.04°C**
	+150 to +420°C	0.006°C	0.15°C**	0.04°C**
C	-200 to +600°C	0.05°C	0.27°C***	0.16°C***
D	-200 to +600°C	0.05°C	0.27°C***	0.16°C***
E	-75 to +150°C	0.06°C	0.3°C**	0.17°C**
F	-75 to +150°C	0.06°C	1.25°C**	0.3°C**

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*
***RTD Temperature ≤150°C*
****RTD Temperature ≤600°C*
Note: Classes A and C allow the user to perform an ice point initialization and improve total system accuracy to be the sum of repeatability plus 0.03°C for 390 and 392 RTDs. The same procedure for a 385 DIN RTD yields total system accuracy to be the sum of repeatability plus 0.03°C plus the RTD probe conformity error.

Resistance Measurement Accuracy (using -164, -174 options)

Max Resistance	Accuracy* ±(% of Rdg + mΩ)	Resolution	Excitation Current
64Ω	0.02% + 7	1 mΩ	1 mA
512Ω	0.02% + 30	10 mΩ	1 mA
Other ranges that may be set by user			
5.12 kΩ	Depends on user's resistor	0.1Ω	0.1 mA
51.2 kΩ		1Ω	0.01 mA

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

Resistance Measurement Accuracy (using -163, -177 options)

Range	Resolution	±(% of Rdg + Ω)	
		Accuracy	Repeatability
256Ω	2.4 mΩ	0.017% + 5.7 mΩ	0.0065% + 5.7 mΩ
2048Ω	19 mΩ	0.017% ±38 mΩ	0.0060% ±38 mΩ
64 kΩ	0.6Ω	0.06% ±1.22Ω	0.0075% ±1.22Ω

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

Option -211, Math Coprocessor (2286A only)

Functions: Absolute value, square root, exponential, sine, cosine, tangent, arc sine, arc cosine, arc tangent, common logarithm, natural logarithm, e^x, exponentiation, integer part, maximum value, minimum value, standard deviation, elapsed time, group average
Logical Operators: AND, OR, NOT, EXCLUSIVE OR
Relational Operators: <, ≤, >, ≥, =, ≠
Interpolation Tables: ≤10, user-entered. Number of points per table is limited only by system memory

Option -341, RS-232C Interface

Data may be output via the RS-232C interface at 110 to 19,200 baud, selectable from the front panel. May be configured to operate on a 20 mA current loop and can serve as the 20 mA current source.

Other RS-232C parameters selected via the front panel include: Data compression format, channel readings per line, start of data sequence, end of data sequence, line termination sequence, and parity.

Acts as a terminal (DTE) or, with an included adapter, as a modem (DCE), or both (with two Options).

Baud: 110, 300, 600, 1200, 4800, 9600, or 19,200
Parity: Odd, even, or neither
Option -341 includes a Y1707 2-meter cable and a Y1705 null modem cable

Option -342, IEEE-488 Interface

Operates as either a talker only, or talker/listener. Easy-to-read thumbwheel switches are used to set the IEEE-488 address and are accessible from the rear panel. Data output parameters selected from the front panel include data compression format and the number of channel readings per line.

Repertoire in Port A: SH1, AH1, T5, L4, SR1, RL1, DC1, E2
Repertoire in Port B: SH1, AH1, T5, L4, SR1 and E2
Order Y8021, Y8022, or Y8023 IEEE-488 cables separately

See page 212 for description of PC compatible software.

2286A, 2285B & 2281A I/O Options

See page 209 for description and pricing of all 228X options.

For These Inputs	I/O Module	Connector	Channels	Max Channels Per Chassis
Thermo-couples	-162**	-175	20	100
DC Voltage	-162**	-176 or -175	20	100
DC Current	-162**	-175	20	100
AC & DC Voltage	-162**	-160	10 AC 10 DC	50 AC 50 DC
RTDs or Ohms	-163**	-177	20	100
RTDs, Ohms Strain	-164**	-174*	20	40
Status	-168	-179	20	120
BCD Digits	-168	-179	5	30
Binary	-168	-179	17 Bits & Sign	6
Frequency	-167/AA	-179	4	20
Frequency	-167	Non Req	6 (2286A only)	30
Totalize Events	-167/AA	-179	4	20
Totalize Events	-167	Non Req	6 (2286A only)	30

**A dc voltage scanner and companion connector Option (-162 and -176) are also required for each Transducer Excitation Option -164 used for RTDs, Ohms, or Strain measurements*

*** A/D Converter (-161) required in chassis*

TC100 Instrument Transport Cart*

The TC100 Instrument Cart provides three levels of work surface, all of them accommodating 19" wide instruments. It easily combines data logger or other instruments, and a printer plus paper supply, on one easily movable work station. The top shelf is adjustable over 25 degrees, and has a safety lock. The cart has a 300 lb capacity. Four 4" casters, two of which can be locked, provide excellent mobility, and options include a line power strip, accessories drawer, and a CPU bracket.

Ordering Information

TC100 Instrument Cart
TC100-01 Opt. Power Strip, 4 outlets, UL listed
TC100-02 Opt. Drawer
TC100-03 Opt. CPU Bracket
TC100-04 Opt. Combination of Power Strip Drawer and CPU Bracket

** Available in North America only*

Ordering Information

Models

2286A* Data Logging System
2285B* Data Logger
2281A** Extender Chassis

** Not functional without at least one input and connector option.*
***One meter extender cable supplied unless -402/-403 option is ordered.*

Included with Instrument

One-year product warranty, line cord, manual set, 3.5" high density disk, 3.5" low density disk, one roll of printer paper, and one pad of programming forms.

Options

-211 Math Coprocessor (2286A)
(factory or service center installation only)
-341 RS-232C Interface
-342 IEEE-488 Interface

See page 209 for descriptions and prices of 228X options for the 2280 SERIES.

Accessories (Also see Section 19)
Y2044 24" Rack Mount and Slide Kit
Y2045 $8^{3}/_{4}$" Rack Mount Kit
Y2046 Thermal Printer Paper (10 pack)
Y2047 Extender Chassis Multi-Connector
Y8091 3.5" Micro-Floppy Diskettes (10 pack)
A22-300 Transit Case for 2280A

Manuals
2280 Start-up Guide (PN 737320)
2280 User Guide (PN 753103)
2280 System Guide (PN 753095)
2280 Series Service (PN 753111)
2281A Operator (PN 655688)
2286/85 User Guide (PN 870170)
2286/85 System Guide (PN 870175)
2286/85 Manual Set* (PN 870167)

**No charge with purchase of unit*

Customer Support Services

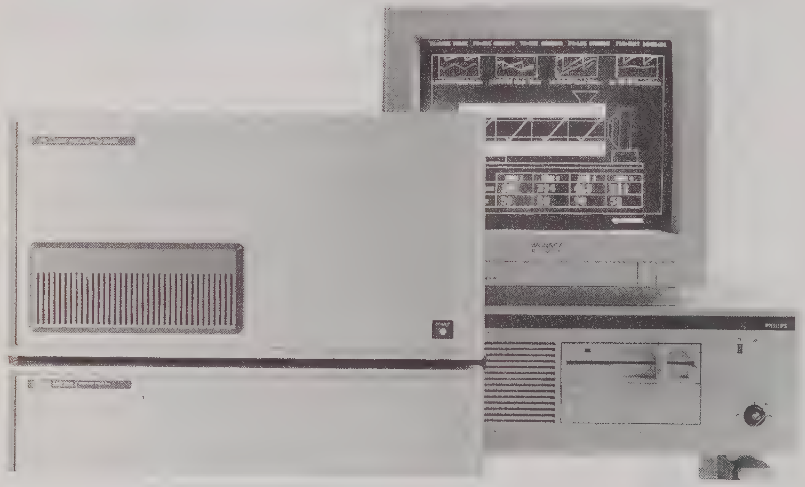
Also see Section 20.

Factory Warranty

One-year product warranty.

Helios Series

RS-232



Helios Plus

Helios I

Helios Series Data Acquisition Front Ends

Helios-I offers high accuracy for lower speed applications

Helios Plus offers higher speed and more intelligence

Wide range of measurement and control options

PC application software available for a complete system

Ruggedized dc powered version for mobile applications

Performance

The Helios Series of Data Acquisition Front Ends add high performance measurement capability to any computer, from lap-top to mainframe.

The Helios Series, composed of Helios-I (2289A) and the more powerful Helios Plus (2287A) gives your computer the power to read:

- Voltage
- Frequency
- Flow
- Strain
- Pressure
- and more
- Temperature
- Speed

The **Helios Data Acquisition Hardware and Software Series** gives you an immediate, cost-effective way to meet your data acquisition goals. With a wide selection of I/O options and software packages, you can tailor your data acquisition system to fit your application.

Helios-I (2289A)

Helios-I is a data acquisition and control subsystem that combines measurement accuracy, excellent noise immunity, and exceptional configuration flexibility in a rugged package.

Helios Plus (2287A)

Helios Plus offers all the features of Helios-I as well as special features for autonomous scanning, data buffering and alarm checking. Measurement speed is faster too – up to 1000 channels per second.

Helios Software

A wide range of general purpose and application specific software gets your data acquisition system up and running in hours, not weeks. Created specifically for Helios, the Helios Logger package takes full advantage of all Helios' features. Or choose from such industry standards as Labtech Notebook™ from Laboratory Technologies, CIM-PAC™ from Action Instruments, Helios Toolbox and many others.

A Wide Range of Measurements

Choose your sensor type. Thermocouples, RTDs, strain gages, pressure, flow, contact closure, frequency, voltage, current, speed, or resistance. The modular architecture of Helios lets you configure your system with all the sensors you want without paying extra for the ones you don't want. It also provides user-defined tables for unusual sensors.

The conversion routines resident in Helios makes your system more cost-effective and efficient. Because you do not have to develop routines for the engineering units conversions, software development is reduced saving you both time and money. And with Helios to take care of those tasks, the host computer is free to do other tasks, improving the system's real-time performance.

These proprietary conversion algorithms, optimized for Helios hardware, are efficient and very accurate. It is difficult to match this performance with a host computer running similar routines.

Choose accuracy: You can add the -161 High Accuracy A/D option to Helios-I or Helios Plus, for extreme accuracy and high isolation in low-level measurements. This is especially important when making thermocouple measurements where high common-mode voltages are present.

Choose speed: With Helios Plus, the -165 Fast A/D option makes measurements at 1000 readings per second in burst mode and 70 readings per second continuous throughput. The overall accuracy of the -165 is unmatched by comparable instruments operating at these speeds.

With Helios Plus, you can combine the -165 with the -161 High Accuracy A/D, to give you precise measurements and fast measurements in a single instrument.

Choose your output type: Analog and binary outputs to control valves, motors, relays, annunciators, alarms and set-point controllers. Manipulate these outputs with simple assignment commands from the host computer to control your test or process.

PC Application Software

The flexibility of Fluke's versatile set of hardware offerings, combined with a selection of software packages, helps you precisely match system capabilities to your application requirements.

Labtech Notebook™ is a flexible data acquisition package for research applications. Its triggering and scanning functions, in combination with a comprehensive set of analysis tools, make it ideal when you require fewer channels and intensive mathematical reduction.

Helios Toolbox for BASIC Programmers, a set of software utilities, speeds software development in almost any application. Take advantage of these programming shortcuts when you need the top performance only custom software can deliver.

CIM-PAC™ is a highly capable monitoring and control package, well-suited to data acquisition in a manufacturing or engineering environment. Its real time animated graphics, networking, and powerful event processor make it easy to customize to large or small applications.

Helios Logger combines your PC with either Helios-I (2289A) or Helios Plus (2287A) to create a powerful data acquisition system. Because Helios Logger offers full access to 2287A functionality, such as high speed measurements, interval scanning, and limit checking, Helios Logger is the package of choice when the power of Helios Plus (2287A) is required.

Other general purpose data acquisition software packages as well as those for specialized applications are available for the Helios Series.

See page 212 for a full description of software information.

Enhance System Performance with Helios Plus (2287A)

For higher performance or remote data acquisition systems, consider the benefits of Helios Plus.

Acquire data rapidly using the Fast A/D Option (2287A-165). The 2287A-165 may be operated in a high throughput "continuous mode" or in a burst mode.

Higher continuous throughput. Each 2287A-165 normally provides readings to the host computer at continuous throughput of up to 70 readings per second.

Burst Mode gives you 1000 readings per second. With the external triggering capability several 2287A-165 A/D Converters will freeze their data buffers for multiple measurement snapshots. To get just the data you need you specify the amount of pre- and post-trigger data to be captured on each A/D. With the addition of a 2287A-265 Memory Expansion Option, each A/D can store up to 79,500 readings for later retrieval.

Automatic sensor scanning, data buffering and alarm detection make Helios Plus ideal for applications that require more local intelligence. With this added intelligence your host computer will have more time for operator interaction, data analysis, and report generation. Helios Plus can schedule its own measurement scans, buffer data, and check for alarms. Since memory is battery backed, you can be sure that Helios Plus will save your latest readings.

Remote/Mobile Data Acquisition Applications

The rugged design of Helios Plus combined with the intelligence to automatically take measurements, check for alarms, buffer data, then provide them on request, makes it ideally suited for remote-site data acquisition. Measurement data may be sent to the local printer port, providing data to on-site operators.

Optional dc powered Helios. The 2287A/AA and 2289A/AA are designed for mobile testing and remote data gathering at sites that lack line power. Both are powered from either a 12V dc or 24V dc supply (8-18 or 21-28V dc respectively) and have an extended operating range to +70°C.

Helios Series I/O Options

Helios Series mainframes and extender chassis use a "card cage" architecture that provides superior configurability because both channel count and channel type are easily adjusted to match your application needs. If a new I/O type is needed, just slide the appropriate option in the next open slot and secure with two captive screws. Configuration and control of these options is easy using any of the available software packages.

The "card cage" architecture provides six slots per mainframe or extender chassis for I/O options. When analog input options are included, one of the six slots must contain an A-to-D converter (2289A-161 or 2287A-165). The high accuracy A-to-D converter (2289A-161) controls one to five 20 channel "scanner" options for up to 100 channels per mainframe or extender chassis. Each fast A-to-D converter (2287A-165) handles inputs directly with a built-in 20 channel scanner. Digital input options each handle 20 channels for up to 120 channels per mainframe or extender chassis. Total system capacity is as high as 1500 channels when extender chassis are used.

Information regarding 228X I/O Options is on page 209 in this catalog.

Specifications

Mainframe Specifications

Mainframe Capacity: 6 option slots
2289A System Capacity: 1500 channels
2287A System Capacity: -161 A/D: 1000 channels; -165 A/D: 800 single-ended, 400 differential
Ambient Temperature: Operating, 0°C to 65°C; storage, -40°C to 70°C
Relative Humidity (without condensation): 0°C to 25°C: <95%; 25°C to 40°C: <75%; 40°C to 50°C: <45%
Altitude: Non-operating, 12 km (40,000 ft); operating, 3 km (10,000 ft)
Shock and Vibration: Meets MIL-T-28800C, Class 5, Style F Standard
Safety: Designed to comply with ANSI/ISA-582, CSA Bulletin 556B, IEC 348, IEC-1010, and UL 1244
Power: AC: 90V to 132V, 180V to 264V, 47 Hz to 440 Hz; DC: 12V or 24V (optional). 40 watts maximum (50 watts maximum dc power)
Weight: 8.5 kg (18.7 lb) without options
Size: 23.8 cm H x 43.9 cm W x 35.9 cm D (9.37 in H x 17.25 in W x 14.13 in D); H (without feet) = 22.2 cm (8.75 in)

2287A Scan Buffer (Non-Volatile)

Data Capacity (Readings)

Channels Per Scan	Readings
1	12,300
5	27,500
10	32,000
20	35,900

Interface Specifications

Type: Asynchronous, either RS-232C or RS-422
Connector: 25-pin male
RS-232C Signals (pin): Shield (1), transmitted data (2), received data (3), request to send (4), clear to send (5), data set ready (6), ground (7), received line signal detector (8), secondary received line signal detector (12), secondary request to send (19), data terminal ready (20), ring indicator (22)
Required RS-232C Signals: Pins 2, 3, 7, all other lines are passively asserted
Required RS-422 Signals: Transmit+, transmit-, received+, received-, common, shield
Baud Rate: 110, 300, 600, 1200, 2400, 4800, 9600, 19200, switch selectable
Data Format: 7 or 8 data bits, 1 or 2 stop bits, switch selectable
Parity: Odd, even or none, switch selectable
Multi-Drop Capability: Available via RS-422. Ten Helios mainframes can be addressed by a host through a single RS-422 port.

See page 209 for a description of all 228X I/O options.

Helios Series

Measurement Accuracy

Accuracy (±% input ±offset)

A/D Option	Range	Resolution[1]	90 Days (15°C to 35°C)	1 Year (15°C to 35°C)	1 Year (-20°C to 70°C)
DC Volts					
-161 A/D	±64 mV	0.5/0.6 µV	±0.005% ±7 µV	±0.01% ±8 µV	±0.03% ±9 µV
	±512 mV	4.2/5.0 µV	±0.005% ±30 µV	±0.01% ±40 µV	±0.03% ±50 µV
	±8V	61/73 µV	±0.005% ±700 µV	±0.01% ±800 µV	±0.03% ±900 µV
	±64V	0.5/0.6 mV	±0.009% ±3 mV	±0.02% ±4 mV	±0.05% ±5 mV
-165 A/D Continuous Mode Differential Input	±64 mV	2 µV	±0.02% ±25 µV	±0.03% ±25 µV	±0.06% ±60 µV
	±512 mV	16 µV	±0.02% ±100 µV	±0.03% ±100 µV	±0.06% ±140 µV
	±8V	0.25 mV	±0.02% ±1.2 mV	±0.03% ±1.2 mV	±0.06% ±1.5 mV
	±10.5V	0.32 mV	±0.02% ±1.7 mV	±0.03% ±1.7 mV	±0.06% ±2.0 mV
-165 A/D Burst Mode Differential Input	±64 mV	2 µV	±0.02% ±35 µV	±0.03% ±35 µV	±0.06% ±70 µV
	±512 mV	16 µV	±0.02% ±150 µV	±0.03% ±150 µV	±0.06% ±190 µV
	±8V	0.25 mV	±0.02% ±1.7 mV	±0.03% ±1.7 mV	±0.06% ±2.0 mV
	±10.5V	0.32 mV	±0.02% ±2.2 mV	±0.03% ±2.2 mV	±0.06% ±2.5 mV
-165 A/D Continuous Mode Single-ended Input	±64 mV	2 µV	±0.02% ±35 µV	±0.03% ±35 µV	±0.06% ±70 µV
	±512 mV	16 µV	±0.02% ±150 µV	±0.03% ±150 µV	±0.06% ±190 µV
	±8V	0.25 mV	±0.02% ±1.2 mV	±0.03% ±1.2 mV	±0.06% ±1.5 mV
	±10.5V	0.32 mV	±0.02% ±1.7 mV	±0.03% ±1.7 mV	±0.06% ±2.0 mV
-165 A/D Burst Mode Single-ended Input	±64 mV	2 µV	±0.02% ±45 µV	±0.03% ±45 µV	±0.06% ±80 µV
	±512 mV	16 µV	±0.02% ±200 µV	±0.03% ±200 µV	±0.06% ±240 µV
	±8V	0.25 mV	±0.02% ±1.7 mV	±0.03% ±1.7 mV	±0.06% ±2.0 mV
	±10.5V	0.32 mV	±0.02% ±2.2 mV	±0.03% ±2.2 mV	±0.06% ±2.5 mV
DC Current					
-161 A/D	±64 mA	0.5/0.6 µA	±0.25% ±4 µA	±0.25% ±5 µA	±0.30% ±6 µA
-165 A/D[2]	±64 mA	2 µA	±0.30% ±12 µA	±0.30% ±15 µA	±0.35% ±18 µA
AC Volts					
-161 A/D	5 to 250V ac[4]	0.1V	±1.0% ±0.1V	±1.0% ±0.1V	±1.5% ±0.2V
Resistance					
-161 A/D, -163, -177	256Ω	2.0/2.4 mΩ	±0.0142% ±5.7 mΩ[3]	±0.02% ±10 mΩ	±0.04% ±13 mΩ
	2048Ω	16/19 mΩ	±0.0137% ±38 mΩ[3]	±0.02% ±50 mΩ	±0.04% ±60 mΩ
	64 kΩ	500/600 mΩ	±0.055% ±1.2 mΩ[3]	±0.06% ±1.8 mΩ	±0.10% ±2.4 mΩ
-161 A/D, -162, -164 -174, -176	64Ω	0.5/0.6 mΩ	±0.02% ±7 mΩ	±0.03% ±8 mΩ	±0.06% ±10 mΩ
	512Ω	4.2/5.0 mΩ	±0.02% ±30 mΩ	±0.03% ±40 mΩ	±0.06% ±60 mΩ
-165 A/D, -164, -174 -176 (continuous)	64Ω	2 mΩ	±0.035% ±25 mΩ	±0.05% ±30 mΩ	±0.10% ±60 mΩ
	512Ω	16 mΩ	±0.035% ±100 mΩ	±0.05% ±100 mΩ	±0.10% ±140 mΩ

[1] *-161 A/D resolution for (50/60 Hz)*
[2] *Using 8Ω ±0.25% shunt mounted on screw terminals*
[3] *18°C to 28°C operating temperature*
[4] *45 Hz to 450 Hz*

Analog Output		Accuracy		
Current or Voltage Output	Resolution	90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year -20°C to +70°C
Option -164 Transducer Excitation Module				
Current Excitation		±0.02%	±0.03%	±0.05%
Voltage Excitation		±0.03%	±0.04%	±0.05%
Option -170				
Analog Output % of Range	2.5 mV or 4 µA	±0.1%	±0.2%	±0.4%

Strain Measurement[1]

Type	Resolution	90 Days (20°C to 30°C)
-161 A/D[2]		
Full Bridge	0.25 µε	±0.05% ±2 µε
1/2 Bridge	0.5 µε	±0.05% ±13 µε
1/4 Bridge	0.5 µε	±0.05% ±25 µε
-165 A/D[3]		
Full Bridge	1.0 µε	±0.1% ±6 µε
1/2 Bridge	2.0 µε	±0.1% ±18 µε
1/4 Bridge	2.0 µε[4]	±0.1% ±30 µε

[1] *-161 and -165 cover full useful range of gage*
[2] *Use with options -162, -164, -174, -176*
[3] *Use with options -164, -174, -176*
[4] *With 4V excitation*

Thermocouples (±°C)

Type & Usable Range (°C)	Measured Temperature (°C)	90 Days 15°C to 35°C		1 Year 15°C to 35°C		1 Year -20°C to 70°C	
		-161 A/D	-165 A/D[2]	-161 A/D	-165 A/D[2]	-161 A/D	-165 A/D[2]
J NBS (-200 to 760)	-100 to -25 -25 to 760	0.45 0.35	1.11 0.95	0.5 0.4	1.16 1.0	0.8 0.7	2.46 2.04
J DIN (-200 to 900)	-100 to -25 -25 to 900	0.5 0.4	1.13 0.9	0.56 0.45	1.17 0.98	0.9 0.7	2.5 2.04
K NBS (-225 to 1350)	0 to 900 +900 to 1350	0.4 0.52	1.2 1.51	0.45 0.65	1.33 1.7	0.7 1.3	2.83 3.6
T NBS (-230 to 400)	-100 to 75 +75 to 150 +150 to 400	0.58 0.35 0.3	1.3 0.95 0.85	0.65 0.39 0.34	1.35 1.0 0.9	1.1 0.7 0.6	3.0 2.05 1.9
T DIN (-200 to 600)	0 to 200 +200 to 600	0.48 0.37	1.04 0.82	0.53 0.41	1.07 0.85	0.8 0.7	2.3 1.81
E NBS (-250 to 838)	-100 to -25 -25 to 750 +750 to 810	0.47 0.3 0.33	1.1 0.88 0.88	0.54 0.33 0.4	1.15 0.94 0.94	0.9 0.6 0.8	2.4 1.93 1.93
N[3] NBS (-200 to 400)	-100 to 150 +150 to 400	0.6 0.4	1.7 1.17	0.7 0.44	1.75 1.2	1.1 0.7	3.9 2.55
R NBS (0 to 1767)	+250 to 450 +450 to 1767	0.9 0.8	3.0 2.71	1.0 0.9	3.0 2.76	1.3 1.4	7.0 6.3
S NBS (0 to 1767)	+200 to 1767	0.97	3.26	1.1	3.3	1.6	7.7
B NBS (200 to 1820)	+600 to 800 +800 to 1820	1.4 0.96	4.3 3.4	1.6 1.1	4.3 3.42	1.9 1.3	10.3 8.12
C HOS (0 to 2315)	+200 to 1000 +1000 to 2000 +2000 to 2315	0.57 0.9 1.3	1.86 3.0 4.1	0.66 1.2 1.7	2.0 3.35 4.55	0.94 2.1 2.9	4.43 7.4 10.1

[1] *Resolution: 0.5°C on R, S, B, and C types; 0.1°C on J, K, L, and T types*

[2] *Continuous Mode only. For burst mode accuracy add 1.0°C to R, S, B, and C types; Add 3.0°C to J, K, E, T, and N types*

[3] *For 28 gauge thermocouple wire*

RTD Performance w/-161, -163, -177 Options

RTD Class	Measured Temperature	Resolution	Accuracy[4]	Repeatability
385 DIN, 392, user-defined 4-wire, high resolution	-200 to +150 +150 to +425	0.006°C 0.006°C	±0.09°C[5] ±0.13°C	±0.03°C ±0.04°C
385 DIN, 392, user-defined 4-wire, high temperature	-200 to +600°C	0.05°C	±0.25°C	±0.14°C
385 DIN, 392, user-defined 3-wire, accurate	-200 to +600°C	0.05°C	±0.007°C[6]	±0.001°C[6]
385 DIN, 392, user-defined 3-wire, isolated	-200 to +600°C	0.05°C	±1.97°C[7]	±1.97°C[7]
10Ω Cu, 4-wire	-75 to +150°C	0.06°C	±0.28°C	±0.16°C
10Ω Cu, 3-wire accurate	-75 to +150°C	0.1°C	±0.065°C[6]	±0.008°C[6]
10Ω Cu, 3-wire isolated	-75 to +150°C	0.1°C	±18.2°C[7]	±18.2°C[7]

RTD Performance w/-161, -162, -164, -174, -176 Options

RTD Class	Measured Temperature	Resolution	Accuracy[4]	Repeatability
385 DIN	-200 to 600°C	0.013°C	±0.2°C	±0.08°C
10Ω Cu	-75 to 150°C	0.1°C	±1.0°C	±0.2°C

RTD Performance w/-165, -164, -174, -176 Options

RTD Class	Measured Temperature	Resolution	Accuracy[4]	Repeatability
385 DIN, 392 & user-defined	-200 to 125°C 125°C to 600°C	0.04°C 0.04°C	±0.4°C ±0.54°C	±0.1°C ±0.1°C

[4] *Total instrument accuracy, 18°C to 28°C, 90 days, (±°C)*

[5] *±0.05°C ±(probe conformity), with ice-point initialization*

[6] *Add, per ohm lead resistance, to 4-wire specs*

[7] *Add to 3-wire accurate specs*

Ordering Information

Models

2287A Helios Plus Mainframe
2289A Helios-I Mainframe
2287A/AA (12V Power)
2289A/AA (12V Power)
2281A Extender Chassis
22810A Helios-I (inc -161, -162 & -175)
22811A Helios Plus (inc -165 & -175)

Included with Instrument

One-year product warranty, line cord, systems manual. 2281A operator manual and serial link cable. With 2281A-431 installed; instruction sheet and power cord.

Options

See page 209 for descriptions of 228X I/O options for the Helios Series.

Accessories (Also see Section 19)
Y1703 RS-232C Null Modem Cable, 4m
Y1705 RS-232C Null Modem Cable, 30 cm
Y1707 RS-232C Standard Cable, 2m
Y1708 RS-232C Standard Cable, 10m
Y2044 24" Rack Slide and 8" Rack Mount Kit
Y2045 8" Rack Mount Kit
Y2047 Serial Link 3-Way Adapter

Manuals
2281A Operator* (PN 655688)
2287A Service (PN 865324)
2287A System Vol 1 & 2 (PN 865295)
2287A System Vol 1 (PN 873799)
2287A System Vol 2 (PN 885186)
2289A System (PN 794768)
2289A Application Software (PN 819862)
2289A Service (PN 834382)
2289A-901 Toolbox (PN 819854)

**No charge with purchase of unit*

Customer Support Services

See Section 20.

Factory Warranty

One-year product warranty.

Helios Series I/O Option Selection Guide

Measurement	I/O Module	Connector	Channels	Max Channels Per Chassis
Thermocouples	-161 and -162	-175	20	100
Thermocouples	-165	-175	20	100
DC Voltages	-161 and -162	-175 or -176	20	100
DC Voltages	-165	-175 or -176	20 DE or 40 SE	120 DE PR 240 SE
DC Current	-161 and -162	-171	20	100
DC Current	-165	-176[1]	20	120
AC Voltages	-161 and -162	-160	10 AC and 10 DC	50 AC and 50 DC
RTDs	-161 and -163	-177	20	100
RTDs	-161 and -162 and -164	-176 and -174	20	40
RTDs	-165 and -164	-176 and -174	20	60
Resistance	-161 and -163	-177	20	100
Resistance	-165 and -164	-176 and -174	20	60
Resistance	-161 and -162 and -164	-176 and -174	20	40
Strain Gage	-161 and -162 and -164	-176 and -174	20	40
Strain Gage	-165 and -164	-176 and -174	20	60
Frequency/ Event Counting	-167	Included	6	30
Status Input	-168	-179	20	120
Binary Input	-168	-179	1	6
BCD Input	-168	-179	5	30
Status Output	-168	-169	20	120
Analog Output	-170	Included	4	24

[1] *Required: 8Ω shunt on each terminal pair, Fluke PN 641449.*

Note on configuration: Each 228X Mainframe chassis or extender chassis has capacity for up to 6 I/O modules. One A/D option is required in each chassis used to measure analog inputs. A connector option is required for every I/O module except the -161, -167, and -170. Up to 5 -162 scanners may reside in a single chassis with a -161. No scanners are used with the -165 A/D.

See page 209 for complete description of 228X I/O options.

The 228X Series of I/O options give you a wide range of choices, for a data acquisition system tailored to your needs. All options are designed to be interchangeable among the 2285B, 2286A, 2287A, 2289A mainframes and 2281A Extender Chassis. Precision engineering at both the module and the system level ensures a data acquisition system that is both accurate and reliable.

Each option is designed for easy installation, allowing quick setup and reconfiguration. Options slide easily into access slots in the mainframe and are secured with two captive screws. Removable connector modules make sensor installation and replacement hassle-free.

Menu-prompted configuration and control makes day-to-day use of your Fluke data acquisition system just as convenient. Using the instrument front-panel or software user-interface, each I/O option is easily configured and operated. Without handling complex switch banks or jumpers, your system becomes an adaptable tool for your data acquisition needs.

228X Series I/O Option Compatibility

Option	Description	2281A	2285B	2286A	2287A[13]	2289A[13]	22810A[13]	22811A[13]	Note
228XX-160	ACV & DCV Input Connector	•	•	•	•	•	•	•	1
228XX-161	A-to-D Converter Card	•	•	•	•	•	#	•	2
228XX-162	Thermocouple/DCV Scanner	•	•	•	•	•	#	•	3
228XX-163	RTD/Ohms Scanner/Excitation	•	•	•	•	•	•	•	4
228XX-164	RTD/Ohms/Strain Excitation	•	•	•	•	•	•	•	5
228XX-167	Counter/Totalizer	•	—	•	•	•	•	•	6
2280A-167/AA	Counter/Totalizer	•	•	•	—	—	—	—	7
228XX-168	Digital/Status Input/Output	•	•	•	•	•	•	•	8
228XX-169	Status Output Connector	•	•	•	•	•	•	•	9
228XX-170	Analog Output Card/Connector	•	—	•	•	•	•	•	6
228XX-171	Current Input Connector	•	•	•	•	•	•	•	1
228XX-174	Transducer Excitation Connector	•	•	•	•	•	•	•	10
228XX-175	Thermocouple/DCV Connector	•	•	•	•	•	#	#	1
228XX-176	DC Voltage Input Connector	•	•	•	•	•	•	•	1
228XX-177	RTD/Ohms Connector	•	•	•	•	•	•	•	11
228XX-179	Digital/Status Connector	•	•	•	•	•	•	•	12
2281A-402	Connecting Cable	14	—	—	—	—	—	—	—
2281A-403	Connector-Pair for -402	14	—	—	—	—	—	—	—
2281A-431	Power Supply for 2281A(s)	15	—	—	—	—	—	—	—
2287A-165	Fast A/D Converter	•	—	—	•	—	—	#	—
2287A-265	Fast A/D Memory Expansion	16	—	—	16	—	—	16	17

Notes: All options are customer-installable except where noted.

• Compatible.

# One included with mainframe.

1 Scanner Option -162 required.

2 One required if Option -162, -163, or -164 is in that mainframe.

3 Connector Option -160, -171, -175, or -176 is required.

4 Connector Option -177 is required.

5 Connector Option -174 and Option -162 with -175 (or -176) also required.

6 Includes connector.

7 Connector Option -179 is required.

8 Option -179 required for inputs. Option -169 required for outputs.

9 Used with Option -168 only.

10 Used with Option -164 only.

11 Used with Option -163 only.

12 Used with Option -168 or -167/AA only.

13 RS-232C Interface is included with the 2287A, 2289A, 22810A and 22811A.

14 A one-meter cable with connectors is included. Order only when longer cable is needed. Connectors come assembled on cable when both ordered.

15 Only needed for very large systems or very remote 2281As.

16 Only one -265 Option per -165 Option.

17 Install on -165 Option

228X I/O Options

Options

Option -160. Alternating Voltage Input Connector

Channels: 10 ac, 10 dc
Terminals: 2/channel
Range: 5V to 250V rms
Frequency: 45 Hz to 450 Hz
Resolution: 0.1V ac

Option -161. High Performance A/D Converter

Dynamic Range: ±131,071 counts at 50 Hz, ±109,226 counts at 60 Hz
Common Mode Rejection: 170 dB at 50 Hz and 60 Hz ±0.1%; 160 dB at dc; 100Ω imbalance
Normal Mode Rejection: 60 dB at 50 Hz and 60 Hz ±0.1%
Isolation: 250V dc or ac rms between option -161 and any other module

Option -162. Thermocouple/Direct Volts Scanner

Channels: 20 (differential only)
Poles/Channel: 3 (Hi, Lo, Shield)
Input Impedance: 64 mV and 512 mV ranges >200 MΩ; 8V and 64V ranges, 10 MΩ
Input Isolation: 250V dc or ac rms between any two channels or any channel and ground

Option -163. RTD/Resistance Scanner

Channels: 20
Poles/Channel: 4 (Hi Excitation, Hi, Lo, Lo Excitation)
Measurements Supported: Resistance, 4- and 3-wire RTDs
Measurement Modes: 4-wire, 3-wire accurate (no relay resistance in measurement path), and 3-wire isolated (no excitation current in measurement path)
Current Sources: Two: 1 mA and 32 μA
Input Isolation: 250V dc or ac rms between any two channels (4-wire and 3-wire isolated), 250V dc or ac rms between decades of channels (3-wire accurate) and 30V dc or 24V ac rms between terminals of a channel

Option -164. Transducer Excitation Module

Capacity: 20 channels, configurable in groups of 4 for either voltage or current excitation
Outputs: 5 constant current, 1 constant voltage
Current Output Range: 1 mA (user modifiable)
Compliance Voltage: 0.6V
Voltage Output Range: 2V dc or 4V dc, switch selectable; maximum current 250 mA

Resistance Measurements
4-Wire: 5 constant current sources factory configured at 1 mA and user-modifiable for other ranges
3-Wire: Uses voltage excitation and user-supplied bridge completion resistors

Strain Measurements
Any combination of 1/4, 1/2 and full bridge strain gages

Option -165. Fast A/D Converter (2287A, 22811A only)

Channels: 20 differential or 40 single-ended. Mixture of SE and DE allowed. Maximum 800 channels per system.

Ranges/Resolution

Range	Resolution
64 mV	2 μV
512 mV	16 μV
8V	250 μV
10.5V	350 μV

Maximum Reading Rates

Continuous Mode (DVIN): 75 channels/sec
Continuous Mode (TC): 43 channels/sec

Burst Mode

Channels Scanned	Channels/Sec
3+	1000
2	666
1	500

External Trigger Input

State	Level
TRUE	<2V
FALSE	>3V

External Trigger Output
Maximum External Pull-Up Voltage: 24V

DC Common Mode Rejection

Range	DC CMR
64 mV	>105 dB
512 mV	>90 dB
8V	>75 dB
10.5V	>70 dB

AC Common Mode Rejection: 160 dB between COMMON and EARTH

Normal Mode Rejection

Burst Scan Mode	Continuous Scan Mode
none	40 dB at 50/60 Hz

Burst Data Buffer Capacity (Readings)

Channels in Burst Scan	Standard Memory	Expanded Memory (2287A-265)
1	5,048	22,922
3	9,800	44,496
10	14,610	66,350
20	16,334	74,160
40	17,000	78,000

Option -167. Counter/Totalizer

Channels: 6
Functions: Event counting and frequency measurement selectable by channel
Signal Types: TTL, CMOS, contacts, and analog waveforms
Adjustments: Signal threshold, deadband, and contact debounce
Input Isolation: 30V dc or ac rms between any terminal and ground. No isolation between channels.

Frequency Measurement
Range: 2 Hz to 400 kHz
Accuracy: 0.01% ±1 digit

Event Totalization
Maximum Counts: 8,388,607
Rate: DC to 400 kHz
Connector: Included with option

Option -167/AA. Counter/Totalizer (2285B, 2286A only)

Channels: 4
Functions: Event counting and frequency, selectable by channel
Signal Types: TTL or contacts
Adjustments: None
Isolation: Each group of four channels isolated from ground
Frequency Measurement: 1000 kHz maximum frequency, 1 Hz resolution

Event Counting
Maximum Counts: 65,534
Operation: Count is reset after each scan. Pseudo-channels are used for count accumulation
Counting Rate: DC to 1 kHz
Connector: Uses -179 Digital/Status & Input Connector (not supplied)

Option -168. Digital I/O

Inputs
Channels: 20 single bits, or one 5 BCD digit word, or one 17-bit binary number and sign
Type: Low Power Schottky TTL
Maximum Input Voltage: 6V

Outputs
Channels: 20 single bits
Type: Open collector, NPN transistors, diode clamped
Drive: 100 mA with 1V drop
Isolation: 30V dc or ac rms between any terminal and ground

Option -169. Status Output Connector

Channels: 20
Terminals: 2/channel

Option -170. Analog Output

Channels: 4

Ranges/Resolution

Range	Resolution
-5V to +5V	2.5 mV
0V to +10V	2.5 mV
4 mA to 20 mA	4 μA

Maximum Current: Voltage output mode, 2 mA
Compliance Voltage: Current output mode, 10V
Isolation: 30V dc or ac rms between any terminal and ground. No isolation between channels. Current outputs share a common return.

Option -171. Current Input Connector

Channels: 20
Terminals: 2/channel
Shunt Resistor: 8Ω ±0.02Ω

Option -174. Transducer Excitation Connector

Channels: 20
Terminals: 5/channel

Option -175. Isothermal Input Connector

Channels: 20 differential, 40 single-ended
Terminals: 3/channel

Option -176. Voltage Input Connector

Channels: 20 differential, 40 single-ended
Terminals: 3/channel

Option -177. RTD/Resistance Input Connector

Channels: 20
Terminals: 5/channel

Option -179. Digital/Status Input Connector

Channels: 20 single bit, or 5 digit BCD or one 17 bit binary word

Option -265. Fast A/D Memory Expansion (2287A only)

Expands the burst mode memory available to the 2287A-165 Fast A/D. The option expands onboard memory from a maximum of 18,000 readings to a maximum of 79,500 readings. Only one memory expansion per Fast A/D (-165).

2281A Extender Chassis

The 2281A Extender Chassis may be used to expand the channel capability of Helios Plus to 1000 channels, and the 2286A and Helios-I to 1500 channels. Connections may be made in daisy chain, star, and maze configurations.
Capacity: 6 option slots
Maximum Distance from Mainframe: 1200m
Power: Supplied from mainframe or 2281A-431 if needed
Cables: 1m cable included
Temperature: All measurement and control options can be installed in the 2281A and meet the following temperature specification:
- **Operating:** -20°C to +70°C
- **Non-Operating:** -40°C to +75°C
- **Humidity:** 0°C to 25°C <95% RH; 25°C to 40°C <75% RH; 40°C to 50°C <45% RH; 50°C to 70°C <40% RH

Weight: 4.3 kg (9.51 lb) with no options
Size: 23.75 cm H x 43.94 cm W x 35.88 cm D (9.35 in H x 17.3 in W x 14.125 in D)

2281A-402 Extender Chassis Cable

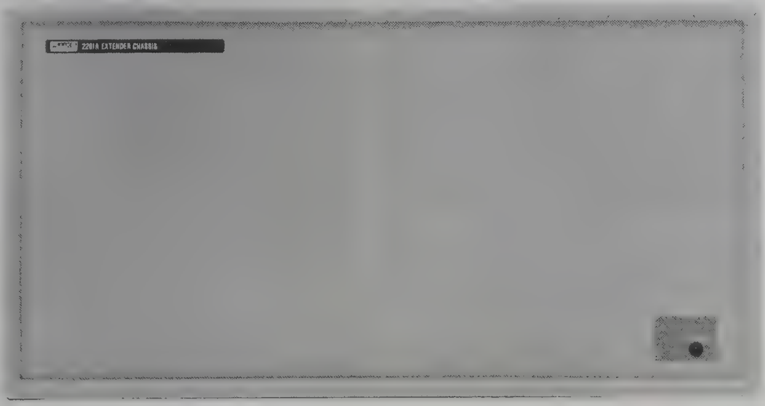
Type: 6 twisted pair, 24 AWG wire with shield; national NQP624SJ or equivalent

2281A-403 Extender Chassis Connector Pair for -402 Cable

Factory installed and tested connector pair for 2281A-402 cable; 15 pin D type connector

2281A-431 Extender Chassis Power Supply

Voltage Ranges: 90V to 132V or 180V ac to 250V ac, 12V dc or 24V dc
Power: 3 to 30 watts depending on 2281A configuration



2281A

Ordering Information

Options

-160 Alternating Voltage Connector
-161 High Accuracy A/D
-162 Thermocouple/DC Voltage Scanner
-163 RTD/Resistance Scanner
-164 Transducer Excitation Assembly
-165 Fast A/D (2287A only)
-167 Counter/Totalizer, w/connector
-167/AA Counter/Totalizer (-179 conn)
-168 Digital I/O Assembly
-169 Status Output Connector
-170 Analog Output Assembly
-171 Current Input Assembly
-174 Transducer Excitation Assembly
-175 Isothermal Input Connector
-176 DC Voltage Connector
-177 RTD/Resistance Connector
-179 Digital/Status Connector
-265 Fast A/D Memory Expansion (2287A-165 only)
-402 Extender Chassis Cable
-403 Connector Pair for -402 Cable
-431 Extender Chassis Power Supply

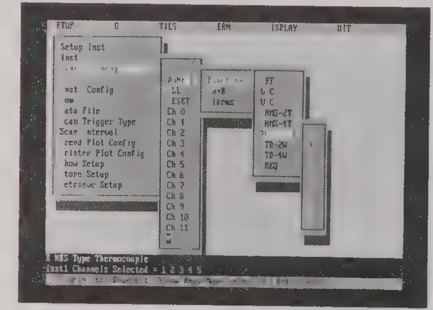
Accessories (Also see Section 19)
Y1703 RS-232C Null Modem Cable, 4m
Y1705 RS-232C Null Modem Cable, 30 cm
Y1707 RS-232C Standard Cable, 2m
Y1708 RS-232C Standard Cable, 10m
Y2044 24" Rack Slide and 8" Rack Mount Kit
Y2045 8" Rack Mount Kit
Y2047 Serial Link 3-Way Adapter

Fluke offers a wide range of PC-based application software for its family of data acquisition instruments. By making your IBM PC (or compatible) an integral part of the system, these software packages allow you to enjoy enhanced display, computation and mass-storage capabilities.

Choose the software that best meets your needs, from "fill-in the blanks" menu driven software to programming tools for the custom system builders. Start with Fluke designed packages which deliver excellent performance since they are designed specifically for use with Fluke data acquisition instruments. These packages range from Hydra Starter, an easy-to-use, and quick start-up package included free in with each Hydra, to Hydra Logger and Helios Logger, in-depth data acquisition packages which are the only programs to provide access to all the powerful features of the Hydra and Helios Series instruments. Or, if you need the flexibility of using a mixture of data acquisition instruments from multiple companies, we offer the popular LabTech Notebook package with drivers for both the Hydra and Helios Series instruments. For the more process oriented applications, we include CIM-PAC for the Helios Series. Consider Fluke hardware and software whenever your application calls for a data acquisition solution.

Hydra Starter Software (revised)
(included with Hydra Series mainframes)

"Starter" software, included with each Hydra Series mainframe, turns your PC or compatible into a capable data acquisition system without any programming. Once you've configured Hydra via the front-panel, Starter takes care of all communication between the PC and Hydra. Connect your PC and Hydra using the appropriate RS-232C cable, specify the port (e.g. COM1:) and Starter does the rest: you don't even have to specify the baud rate. With Starter you can download instrument configurations from disk files, scan up to 21 input channels, store data on disk, display readings: all the basic data acquisition functions are included. Operates with one Hydra mainframe.



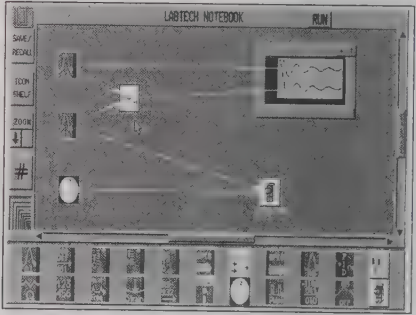
RMS Type Thermocouple
Inst1 Channels Selected = 1 2 3 4 5

Hydra Logger Software (revised)
(Fluke Model 26XXA-901)

The Hydra "Logger", menu system allows you to use your PC's mouse or keyboard to set up Hydra's functions and operation. Logger supports up to two Hydra instruments at one time via either COM port (RS-232C) or an IEEE-488 interface (compatible with National Instruments NI-488 MS-DOS software). Logger controls Hydra's scanning, collects data, graphs any eight channels in real-time, and creates a data file which may be directly imported into Lotus® 1-2-3 and other spreadsheets for further analysis. When used under Microsoft® Windows™ 3.x (386 enhanced mode), Logger provides real-time data to other Windows applications via Dynamic Data Exchange (DDE). This package also has the ability to drive the PC's printer as a strip chart recorder. By specifying from one to 21 channels (42 channels if operating two Hydras), a strip chart-like output is printed in real-time for later examination and archival. All of these capabilities are controlled via simple menus on your PC's display, either through a keyboard or mouse.

Logger now includes a new 2635A Data Bucket menu section which provides users with quick-easy access to Data Bucket features. Logger can copy files from a Data Bucket memory card to the PC, format the memory card, delete memory card files and more. Logger can even store Data Bucket configuration information on the memory card, so that the Data Bucket can be set-up in the field by a less technical user and begin logging data with the press of a button.

Logger also includes a "pruning and grafting" utility which allows users to extract critical data from a large memory card data files, or to combine data from multiple memory cards into a single file and to aid in data organization and analysis.



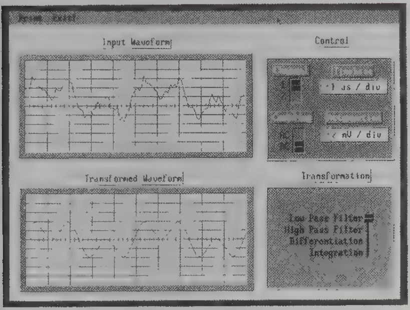
Labtech Notebook Software for Hydra and Helios Series
(Fluke Model S2290)

Versatility and fast set up makes Labtech Notebook an ideal data acquisition package for research and development applications. Menu-based setup results in fast configuration and quick start-up. Notebook also includes a complete tutorial to aid the novice user.

Notebook can record data (and time-of-measurement) into multiple files, allowing concurrent acquisition and organization of data. A variety of data formats are available for easy use with other analysis and graphics packages.

Real-time data display in a variety of formats allows the user to track critical measurements during the data acquisition run. Notebook can perform calculations in real-time using one or more channels and the result can be displayed and stored.

As purchased from Fluke, Labtech Notebook includes drivers for the Helios Series (2287A and 2289A) and the Hydra Series (2620A and 2625A). This allows all the functionality from all these instruments to be used in a common user interface. For example, Labtech Notebook supports both high accuracy measurements (±0.005% of input) and high speed measurements (1000 readings per second).

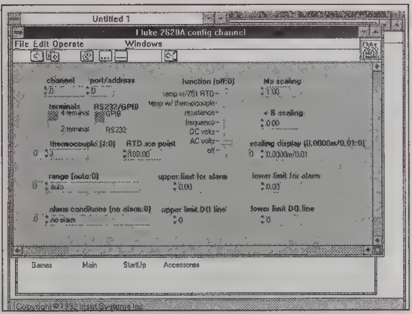


Hydra LabWindows Driver

National Instruments LabWindows® 2.x provides programmers with a complete, easy-to-use environment for the generation and execution of data acquisition software written in Microsoft QuickBASIC,® Professional BASIC or C. LabWindows reduces development time by providing libraries that cover every stage of program development and execution – data acquisition, data analysis, and data presentation.

The LabWindows programming environment provides an editor and a large number of standard functions and libraries, including a new Graphical User-Interface Library. User-interface functions include menus, numeric displays, slide switches, ring controls, simulated LEDs, text boxes, graphs and strip charts. PCX images can be used to create advanced displays, e.g. test system schematics or process diagrams.

The Hydra LabWindows driver is available from Fluke. Contact your local Fluke representative for more information. LabWindows is available from National Instruments.


Untitled 1
Fluke 2620A config channel
File Edit Operate Windows
Games Main StartUp Accessories
Copyright © 1992 Insight Systems Inc

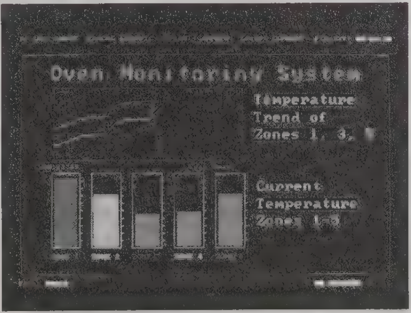
channel 0
port/address 0
function (off:0) temp w/751 RTD, temp w/ thermocouple, resistance, frequency, DC volts, AC volts, off
Mx scaling 1.00
terminals 4 terminal, 2 terminal
RS232/GPIB GPIB, RS232
+ B scaling 0.00
thermocouple (J:0) J
RTD ice point 100.00
scaling display (0.0000m/0.01:0) 0.0000m/0.01
range (auto:0) auto
upper limit for alarm 0.00
lower limit for alarm 0.00
alarm conditions (no alarm:0) no alarm
upper limit DO line 0
lower limit DO line 0

Hydra LabVIEW Driver

National Instruments® LabVIEW® is a graphical programming system for data acquisition, data analysis, and data presentation. LabVIEW offers an innovative programming methodology in which users graphically assemble software modules called virtual instruments (VIs). Users build VIs to acquire data and then analyze the data and present the results through a graphical user interface. VIs allow users to focus on the application using familiar block diagrams instead of spending time with a text-based programming language.

With LabVIEW, users build VIs instead of writing programs. Front panel user interfaces can quickly be created which provide interactive control of software systems. To specify functionality, users intuitively assemble block diagrams. The block diagram is the actual program, allowing users to avoid the time-consuming task of converting ideas into cryptic text-based code.

The LabVIEW driver is available for both LabVIEW for Windows and LabVIEW for Macintosh. Both LabVIEW and the Hydra LabVIEW drivers are available from National Instruments.


Oven Monitoring System
Temperature Trend of Zones 1, 3,
Current Temperature Zones 1-5

CIM-PAC Software for Helios Series

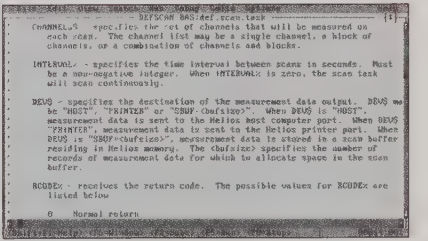
(Fluke Model 2289A-902)

CIM-PAC is a full-featured monitoring and control package, well-suited to data acquisition in a manufacturing or engineering environment. Its real-time animated graphics, networking and powerful event processor make it appropriate for more complex applications. All functional modules are standard and accessable during run-time through CIM-PAC's built-in multitasking operating system. CIM-PAC's menu programming and context sensitive "help" screens accelerate system set-up.

CIM-PAC goes beyond the capabilities of most data acquisition software packages by allowing extensive customization of the "run-time" operation. Detailed process graphics can be constructed and animated giving the operator a quick view of the process being monitored. Multiple graphic screens can be used for differing views or as a "zoom" feature. Motion and color highlight changes in the process. A user can interact by acknowledging events, changing parameters or manually controlling the process or test. Historical trends are available at any time. Data recorded to disk may be converted to DIF format for use by spreadsheet and analysis programs.

In addition to acquiring and logging data CIM-PAC maintains an "Alarm Log" that can be used to record exceptional conditions, notify the operator of such occurances. If desired CIM-PAC can be configured to require operator acknowledgement and also record time of acknowledgement.

If you want the benefits of "custom" data acquisition system software without the usual time and expense associated with writing it, choose CIM-PAC.



```
DEFSCAN BAS:def.scan.task
CHANNELS$  specifies the set of channels that will be measured on
   each scan.  The channel list may be a single channel, a block of
   channels, or a combination of channels and blocks.

INTERVAL% - specifies the time interval between scans in seconds.  Must
   be a non-negative integer.  When INTERVAL% is zero, the scan task
   will scan continuously.

DEV$ - specifies the destination of the measurement data output.  DEV$ m
   be "HOST", "PRINTER" or "SBUF-<bufsize>".  When DEV$ is "HOST",
   measurement data is sent to the Helios host computer port.  When DEV$
   "PRINTER", measurement data is sent to the Helios printer port.  When
   DEV$ is "SBUF=<bufsize>", measurement data is stored in a scan buffer
   residing in Helios memory.  The <bufsize> specifies the number of
   records of measurement data for which to allocate space in the scan
   buffer.

RCODE% - receives the return code.  The possible values for RCODE% are
   listed below

   0    Normal return
```

Helios Toolbox

(Fluke Model 2289A-901)

Helios Toolbox for BASIC programmers is a set of software utilities that speeds software development in almost any application. These routines are used in the Microsoft QuickBASIC program development environment. These routines are intended to simplify software development by providing Helios-to-computer communications, automatic error checking, and buffer management routines. Special routines for Helios Plus (2287A) manage interval scanning, data buffering, alarm limit checking and "Burst Mode" (1000 channels per second) capability. Toolbox will even record your data directly into Lotus 1-2-3 Worksheet format.

You'll find that Helios Toolbox will significantly reduce software development time. Take advantage of these programming shortcuts when you need the top performance only custom software can deliver.

Helios Logger Software (NEW)

(Fluke Model 2289A-903)

Helios Logger, is a general purpose software package that combines your PC with either Helios-I (2289A) or Helios Plus (2287A) to create a powerful data acquisition system. This is the package of choice when the additional functionality of Helios Plus (2287A) is required.

The Helios Logger menu system allows you to set up and control both the 2287A and 2289A mainframes and all their associated options. Control scanning, collect data, graph channels in real-time, and create data files that can be imported directly into Lotus 1-2-3 and Microsoft Excel® spreadsheets. When used under Microsoft Windows 3.0 (386 enhanced mode), Helios Logger software provides real-time data to other Windows applications via DDE.

Ordering Information

Models

262XA-901 Hydra Data Logger
S2290 Labtech Notebook
2289A-902 CIM-PAC
2289A-901 Helios Toolbox

Data Acquisition Application Software, MS-DOS Based

Instrument	Software	Data File Format	Real-Time Display	Analysis Functions	Network	Configures Instrument
Hydra 2620A, 2625, 2635A	Hydra Starter	ASCII, Binary, DIF	Numeric	Scale inputs	No	No
Hydra 2620A, 2625A, 2635A	Hydra Logger	ASCII, Binary, DIF	Numeric, Trend graph Windows DDE	Scale inputs	No	Yes
Hydra 2620A, 2625A	LabWindows	ASCII, Binary	Numeric, Trend graph, X-Y	Standard and Advanced Analysis Package	No	Yes
Hydra 2620A, 2625A Helios 2287A, 2289A	Labtech Notebook	ASCII, Binary	Numeric, Trend graph, Bar graph, X-Y	Scale inputs, Stat, FFT, Trig, Logical	No	Yes
Helios 2287A, 2289A	Helios Logger	ASCII, Binary, DIF	Numeric, Trend graph Windows DDE	Polynomial*, Square Root*, Interpolation table	No	Yes
Helios 2287A, 2289A	Helios Toolbox	ASCII, Binary	BASIC graphic package	BASIC math routines	No	No
Helios 2289A	CIM-PAC	ASCII, DIF	Numeric, Trend graph, Bar, X-Y, Animation	Scale inputs, Stat, Logical, Trig	Yes	Yes

**Helios Plus (2287A) only*

Fluke 51 & 52

Available through Distributors

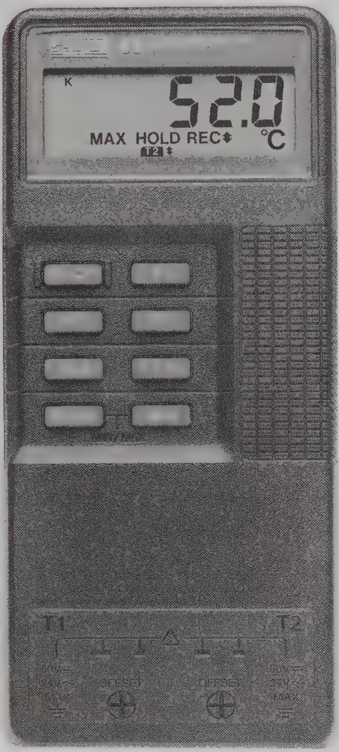
Fluke 51

Fluke 50 Series Thermometer

- Self-test
- J- or K-type thermocouples
- °C or °F display
- Reading hold function
- Single thermocouple input
- 1°C or 0.1°C (1°F or 0.2°F) resolution

The Fluke 51 & 52 Digital Thermometers are designed for high accuracy and resolution with excellent repeatability. Their price/performance ratio is unmatched in the industry. Reliability, a three-year warranty, and 1200-hour battery life combine to give users the lowest possible cost of ownership.

The Fluke 51 is a high quality, high performance Digital Thermocouple Thermometer. The most demanding users will get everything they expect and more from this rugged, single-input unit.



Fluke 52

Additional for the Fluke 52

- Dual thermocouple input
- Differential temperature (T_1-T_2)
- Scan function (T_1, T_2, T_1-T_2,...)
- Min/Max record
- User-selectable resolution
- 1°C or 0.1°C (1°F or 0.2°F)

The Fluke 52 has several additional measurement functions and high-performance features. Dual inputs (T_1 and T_2) allow two individual points to be monitored, and provide information for the differential mode (T_1-T_2). A Min/Max register is available for any input (T_1, T_2 or T_1-T_2). At power-up the user can select a "scan" mode, which scrolls through the three modes in a T_1, T_2, T_1-T_2 continuous sequence. Also selectable at power-up is the choice of high resolution (0.1 degrees C or 0.2 degrees F) or low resolution (1°C or 1°F) readouts.

Specifications

Technical Specifications

Temperature Scale: Celsius or Fahrenheit user-selectable

Resolution: 1°C or 1°F (or 0.1°C or 0.2°F) user-selectable

Thermocouple Types: K-type or J-type that conform to NBS and IEC 584 tables, user-selectable

Measurement Range: K-type range is -200°C to 1370°C (-328°F to 2498°F). J-type range is -200°C to 760°C (-328°F to 1400°F). Also check the rated range of the thermocouple to be used. For Fluke K-type probes see Multimeter Accessories.

Meter Operating Range: For use in 0°C to 50°C environment (32°F to 122°F)

Meter Accuracy: Specified for a period of one year when meter is operated in an environment of 18°C to 28°C (64°F to 82°F). Thermocouple errors should be added to meter errors to determine measurement accuracy. See thermocouple manufacturer's data.or, for Fluke K-type probes, see Multimeter Accessories.

Model	Accuracy ±(% of Rdg + °C)		Accuracy ±(% of Rdg + °F)	
	Type K	Type J	Type K	Type J
51 or 52	0.1% + 0.7°C	0.1% + 0.8°C	0.1% + 1.3°F	0.1% + 1.4°F
52* T_1-T_2	0.1% + 1.0°C	0.1% + 1.2°C	0.1% + 1.8°F	0.1% + 2.2°F

**Typical accuracy only for T_1 minus T_2 temperature*

Temperature Coefficient: Within the meter operating range, add to the meter accuracy specification 0.01% of reading +0.03 degrees for each degree below 18°C (64°F) or above 28°C (82°F)

Error Offset: Errors contributed by one particular thermocouple may be practically eliminated, over a limited measurement range, using a recessed front panel OFFSET adjustment on the meter and an accurate temperature standard when making the adjustment. Although making that adjustment may increase measurement errors made using other thermocouples, the two-input Model 52 offers a means of adjusting one input and dedicating it to making particularly accurate measurements while using the other input for all other thermocouples.

Input Connectors: For standard miniature K-type or J-type polarized thermocouple plugs with flat, in-line blades spaced 7.9 mm (0.312 in) center to center.

Maximum Input: 60V dc or 24V rms ac between the input pins or any input and ground. Maximum of 1V between inputs T_1 and T_2 on the Model 52.

Reading Rate: 1 second per reading for one probe, 1.7 seconds per reading in the scan mode with the Model 52.

Fluke 51 & 52

Storage Temperature: -40°C to 60°C (-40°F to 140°F)
Relative Humidity: To 90% up to 35°C (95°F); to 70% up to 50°C (122°F)

General Specifications

Battery: Standard 9V battery (NEDA 1604, 6F22, or 006P)
Battery Life: 800 hours. Low battery indicator appears when less than 50 hours of battery life remain
Safety: Protection Class III as defined in IEC 348, Safety Requirements for Electronic Apparatus and UL 1244
Warranty: Three years
Size: 28 mm H x 75 mm W x 166 mm L (1.12 in H x 2.95 in W x 6.55 in L)
Weight: 280 gm (10 oz.)

Ordering Information

Models

51 Digital Thermometer
52 Digital Thermometer

Included with Instrument

Three-year product warranty, battery, 80PK-1 probe for general purpose measurements (two with the 52), and Operator's manual.

Accessories (Also see Section 7)
80PK-1 Bead Air Probe
80PK-2A Immersion Probe
80PK-3A Surface Probe
80PK-4A Air Probe
80PK-5A Piercing Probe
80PK-6A Exposed Probe
80CJ-M Male Connector, Type J Mini (pkg. of 2)
80CK-M Male Connector, Type K Mini (pkg. of 2)
C90 Soft Carrying Case
C50 Compact Soft Case
C70Y Protective Holster (Yellow)
C70G Protective Holster (Grey)
C100 Universal Hard Carrying Case

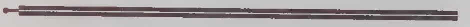
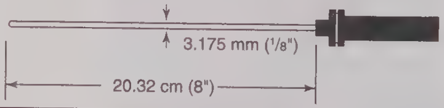
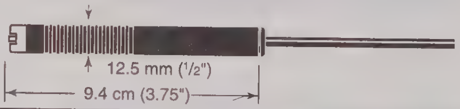
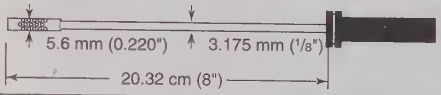
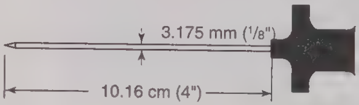
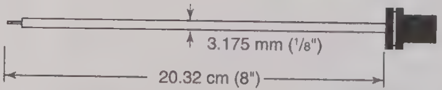
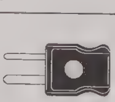
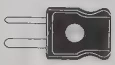
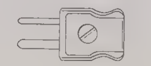
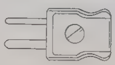
Manuals
51 Operator*
52 Operator*
51/52 Service
51/52 Service w/Alignment Tools

**No charge with purchase of unit*

AVAILABLE THROUGH DISTRIBUTORS

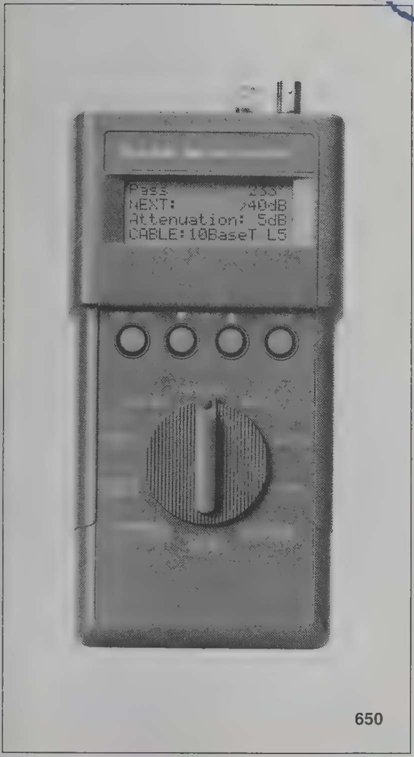
K-Type, Thermocouples

(See Section 7 for specifications)

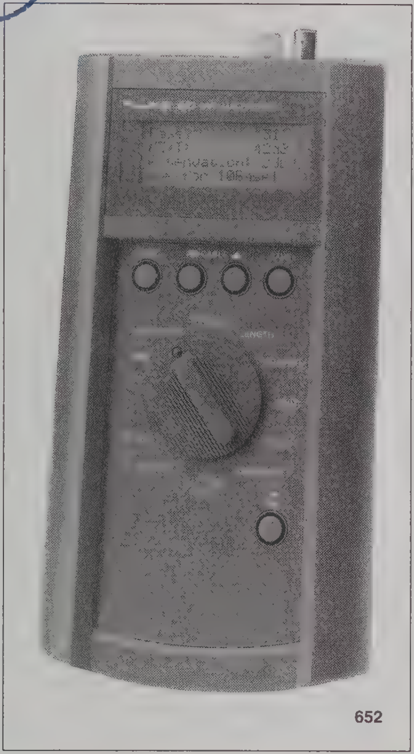
Model	Range	Style
80PK-1 Bead Air Probe	-40°C to 260°C (-40°F to 500°F)	
80PK-2A Inconel Sheath Immersion	-196°C to 1090°C (-320°F to 1922°F)	
80PK-3A Surface Probe	-28°C to 260°C (-18.4°F to 500°F)	
80PK-4A Air Probe	-196°C to 816°C (-320°F to 1500°F)	
80PK-5A Stainless Steel Piercing Probe	-196°C to +816°C (-320°F to 1500°F)	
80PK-6A Exposed Probe	-196°C to +816°C (-320°F to 1500°F)	
80CK-M Male Type K Mini Connector (pkg of 2) (20 AWG Max)	N/A	 
80CJ-M Male Type J Mini Connector (pkg of 2) (20 AWG Max)	N/A	 

650 & 652

NEW



650



652

650 & 652 LAN CableMeters

- Troubleshoots coax and unshielded twisted pair cables used in Ethernet, Token-Ring, and many other networks
- Wire Map detects both correct and faulty wiring
- Built-in TDR finds cable length and distance to fault
- NVP calibration to user cables for improved length accuracy
- Measures termination and characteristic impedance
- Measures near-end crosstalk (NEXT), attenuation, and detects split pairs
- Bar Graph indication of Ethernet traffic activity on a live network
- Time-stamped noise monitoring
- Automatic power shutdown
- Soft carrying case for convenient transport and storage
- Accessory cables and adapters included

The Fluke 650 LAN CableMeter offers the right combination of performance, features and ease of use for rapid problem diagnosis and certification of LAN cables. It is ideal for use by cable installers, LAN maintainers and managers who work with both unshielded twisted pair (UTP) or coaxial cables.

The Fluke 652 CableMeter is the only single instrument that provides a complete suite of tests; from wire mapping to noise and traffic measurements; from Near-end (NEXT) to identifying split pairs. It also has a bright back-lit display and a long battery life.

Intuitive, Easy to Use

A simple rotary knob eliminates confusing multi-level menus and repetitive button pushing. Plus an audible beeper alerts for correct operation and pass/fail operation.

Near-End Crosstalk (NEXT)

Measures crosstalk between wire pairs in twisted-pair cables. Near-end Crosstalk (NEXT) of less than 20 dB is used to warn user of a possible split pair.
Range: 0-48 dB
5 MHz to 10 MHz in 100 kHz steps
10 MHz to 20 MHz in 200 kHz steps
Accuracy: ±2 dB

Professional Certification Reports

Cable installers often need to certify that cables are installed properly and can offer proof by printing a certification report via the serial printer port.

Cable Types

Unshielded Twisted Pair (UTP): 10 BaseT: Level 3,4,5, and IBM Type 3 Level 3, 4, 5, IBM Type 1; Coaxial: 10Base2, RG58, RG58 Foam, RG59, RG59 Foam, RG62, 10Base5. Also allows two custom cable types with selection of characteristic impedance, Nominal Velocity of Propagation (NVP), and BNC or RJ-45 (Ethernet or Token-Ring wired) connectors.

Display

64 character, four line LCD with backlight.

Specifications

Technical Specifications

Measurements: Length, wire map, attenuation, Near-end Crosstalk (NEXT), characteristic and termination impedance, noise and Ethernet traffic

Length: (Built-in TDR is used to make this measurement)
Range: 20 ft to 2000 ft (6m to 600m) for UTP Cable; 20 ft to 4000 ft (6m to 1200m) for Coaxial Cable
Accuracy: ±1% reading + 2 ft (0.6m)
Resolution: 1 ft (1m)
Display Units: Feet or meters

Wire Map: Detects correct and faulty pair wiring in cables with RJ-45 connectors. Indicates the following faults: opens, shorts, reversed pairs, and crossed pairs.

Near-End Crosstalk: 0 to 40 dB, 5 to 10 MHz in 100 kHz steps; accuracy ±2 dB
Attenuation: Measures attenuation of twisted pair cables. Range: 0 to 48 dB, 5 MHz to 10 MHz in 100 kHz steps; 10 MHz to 20 MHz in 200 kHz steps; accuracy ±2 dB

650 & 652

Noise: Counts noise impulses above a user-selectable threshold level on an idle network cable. Displays pass/fail results, elapsed time, impulse counts/sec, test limit 0.2/sec. max., and time-stamped highest peak impulse counts/sec.
Traffic: Monitors live network traffic on 10BaseT or coaxial Ethernet networks
Characteristic Impedance Accuracy: ±10Ω
Termination Resistance Accuracy: ±10Ω

General Specifications

Network Topology: 10BaseT or coaxial Ethernet and UTP Token-Ring
Cable Types: Unshielded Twisted Pair (UTP): 10BaseT and IBM Type 3, Levels 3, 4, 5; Coax: 10Base2, RG58, RG59, and RG62. Also, four user-definable cables.
Display: 64 character, 4 line LCD
Printer Port: RS-232C, DB9P connector, IBM-AT serial pinout, 1,200 - 19,200 baud, 8 bits, no parity, 2 stop bits. TD, RD, CTS, DTR signals supported.
Connectors: BNC and RJ-45 (IEEE 802.3 electrical interface). Inputs withstand telco ringing and loop voltages. Audible and display alarms on overvoltage faults.

CableMeter Measurements for Ethernet and Token-Ring Networks

Measurement Capabilities	Ethernet		Token Ring
	10BaseT	Coax	UTP
Autotest*	•	•	•
Length (TDR)	•	•	•
Wire Map	•		•
Opens, Shorts	•	•	•
Crossed Pairs	•		•
Reversed Pairs	•		•
Split Pairs*	•		•
Near-End Crosstalk (NEXT)*	•		•
Attenuation*	•		•
Characteristic Impedance	•	•	•
Termination Resistance		•	
Cable Calibration	•	•	•
Noise	•	•	•
Traffic	•	•	

**Measurement made to 10 MHz with 650 CableMeter; to 20 MHz with 652 CableMeter*

Features	610*	650	652
RJ-45 input connector	•	•	•
BNC input connector		•	•
Tests UTP cable	•	•	•
Tests STP cable	•		•
Tests Coax cable		•	•
Cable library		•	•
LED display	•		
LCD display		•	•
LCD backlight			•
Wire Map	•	•	•
Measures length (TDR)		•	•
Measures distance to faults		•	•
Measures NEXT to 10 MHz	•[1]	•	•
Measures NEXT to 20 MHz			•
Cable identification	•		
Cable certification for 10BaseT		•	•
Cable certification for 4Mbps Token Ring		•	•
Cable certification for 16Mbps Token Ring			•
Tests per IEEE specifications			•
Tests per EIA/TIA 568 specifications			•
Cable certification report printouts		•	•
Noise tests		•	•
Ethernet traffic monitor		•	•
Traffic printout		•	•
Measures Attenuation to 10 MHz		•	•
Measures Attenuation to 20 MHz			•

* *See page 220*
[1] *NEXT measured at 10 MHz only to determine split pairs*

Temperature: 0°C to 50°C operating; -20°C to 60°C storage
Humidity: 10% to 90% relative humidity, non-condensing
Power: Replaceable 9V alkaline batteries or 120V ac line adapter. 652 CableMeter, 6 AA alkaline battery, 650R Remote Unit, one 9V alkaline battery. Typical 8 hours of continuous operation. To conserve batteries, the 652 automatically shuts down during idle test periods.

Size
650: 4.3 cm H x 10.2 cm W x 19.3 cm L (1.7 in H x 4 in W x 7.6 in L)
652: 23.3 cm H x 12.7 cm W x 4.7 cm L (9.15 in H x 5.0 in W x 1.85 in x 1.85" L)
650R: 9.6 cm H x 7.3 cm W x 3.6 cm L (3.75 in H x 2.85 in W x 1.4 in L)

Weight
650: 600g (1.3 lb)
652: 0.7 kg (1lb 10 oz)
650R: 0.16 kg (5.5 oz)

Ordering Information

Models

Fluke 650 LAN CableMeter
Fluke 652 LAN CableMeter

Included with 650
Remote unit, 2 RJ-45 patch cables, RJ-45 clip lead cable, 2 RJ-45 couplers, 50Ω BNC cable, ac line adapter, 2 spare 9V batteries, soft carrying case, manual.

Included with 652
650R Remote Unit, ac adapter, soft carrying case, manual and warranty registration card. N6520 Cable Kit contains: (2 each) RJ-45 patch cables; (2 each) RJ-45 8 clip lead cables; (2 each) RJ-45 female couplers; (1) 50Ω BNC coaxial cable and (1) printer cable, DB9 to DB25.

Accessories
650R Replacement Remote Unit
C650 Replacement Soft Carrying Case
N6521 STP Adapter Kit (consists of: RJ-45 DB9 Adapter and RJ-45 IBM Data Connector Adapter

EW

670

670 LANMeter™

- LAN-AT-A-Glance LEDs
- Expert-T Autotest
- Automatic insertion at correct ring speed
- Phase Jitter Measurements
- Real-Time Graphic Analysis
- Simultaneous Key Measurements (stats, stations, errors)
- "No Dead Zone" TDR Measurements
- Nic/MAU Tests
- Automatic Identification of New and Missing Stations

The Fluke 670 LANMeter is a powerful instrument designed to test and troubleshoot a vast array of Token Ring Local Area Network problems quickly and easily. The LANMeter allows the user to quickly isolate many problems that occur on a network or with network components, and may also be used to diagnose problems that occur with network cabling. All without programming, setting filters, or decoding complex protocols.

Additionally, the LANMeter helps to proactively maintain a healthier network by monitoring important attributes of the network environment such as the state of servers, bridges and routers.

Ease of Use

From the moment you pick it up, you will find the LANMeter's front panel simple and straight forward. Every key is clearly labelled and pop-up menus with five soft function keys provide fast, confident control of all your options. The LCD display is bright and crisp, presenting information in an easy to interpret form. LED status indicators together with pie, bar and trend graphs provide at-a-glance, easy to understand overviews of network health.

Finally, the LANMeter's go-anywhere portability and battery operation allows you to troubleshoot problems where they most often occur; in an office or wiring closet, making it the perfect one-tool troubleshooting package.

Quick Problem Isolation

The unique functionality of the LANMeter allows you to quickly isolate the most common problems that occur on a Token Ring LAN. The Fluke 670 LANMeter is the only single instrument in a handheld package capable of pinpointing cable, component, and network problems.

New Device Verification

Minimize installation problems by using the LANMeter to verify correct operation of network interface cards, cabling and MAUs before they have a chance to impact network operation.

Support You Can Count On

The LANMeter's Flash ROM Technology protects your investment by allowing quick and easy software updates using your PC. And, if anything should go wrong, you can count on Fluke's worldwide service and support to get you up and running fast.

Specifications

Measurement Accuracy Specifications

DC Resistance: 500Ω to 500 kΩ ±10%
Cable Length: 0 to 30 meters (0 to 100 ft) ±(1% of reading + 0.3m [1 ft]); 30 to 300 meters (100 to 1000 ft) ±2% of reading
Phase Jitter: 4 Mbps Token Ring ±2.5 nsec; 16 Mbps Token Ring ±0.5 nsec

General Specifications

Keyboard: Alphanumeric and dedicated keys
Display: Bit-mapped LCD (240 x 128 pixels)
LED Indicators: 19
Power: Rechargeable NiCad with average 3 hours operating time. Recharges in one hour.

Communication Ports: MAU and NIC connectors, (DB 9 and RJ45) RS-232C serial port

Operating Temperature:
10°C to 30°C with 95% RH
10°C to 40°C with 75% RH
10°C to 50°C with 45% RH

Flash Memory: Update instrument software via serial port
Size: 29.2 cm H x 16.3 cm W x 5.6 cm D (11.5 in H x 6.5 in W x 2.2 in D)
Weight: 2 kg (4.5 lbs)

Ordering Information

Model

Fluke 670 LANMeter

Included with Instrument

Battery pack (installed), instrument case, AC adapter/battery charger, remote unit, software utilities (on 3.5" media) and user manual.

Accessories

N6700 Soft Carrying Case
N6701 Spare Battery Pack
N6703 UTP Accessory Kit:
  66 punch down to RJ-45 adapter
  110 punch down to RJ-45 adapter
  RJ-45 femalecoupler
  RJ-45 to clip lead cable
  RJ-45 cable (Type 3, 2 m [6 ft.])
N6704 Lobe Monitor Kit:
  DB-9 male to male STP cable
  RJ-45 cable (Type 3, 2 m [6 ft.])
  IBM data connector to DB-9 male adapter
N6708 Cable Locator Kit 1:
  (6) Cable Locator Units (#'s 1- 6)
N6709 Cable Locator Kit 2:
  (6) Cable Locator Units (#'s 7- 12)

NEW

610

610 LAN CableMapper

- 610 CableMapper determines UTP termination faults per LAN cabling standard EIA/TIA 568 for Ethernet and Token Ring LANs
- Measures Near-end Crosstalk (NEXT) for split pair identification
- Fault codes and cable identifier number indicated directly on front panel
- Bright LEDs signify pass (green) or fail (red) for each pair
- Lightweight, handheld design for portability
- Handy carrying case organizes 610, Cable Identifiers and manual
- Protective holster

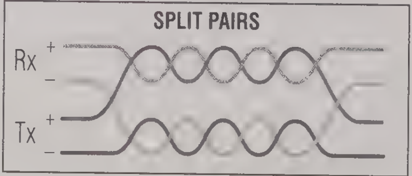
The new Fluke 610 CableMapper is designed to find all UTP termination faults at the touch of a button and detect split pairs - something no other wiremapper can do.

Unique Cable Identification Function

Cable Identifiers simply plug into a termination point - such as where an office or desk will be located. Then, connect the 610 to the other termination point - in the wiring closet, for example. The 610 will automatically display the unique ID number of the identifier plugged in. Each 610 includes one free Cable Identifier. Sets of additional identifiers are available as options.

Split Pair Identification

In addition to continuity checks, Fluke's 610 measures Near-end Crosstalk (NEXT) for split pair identification.



A split pair wiring error occurs in twisted pair cabling when a balanced circuit uses one wire from one pair and the other wire from a different pair. While the cable may have correct pin-to-pin continuity, excessive crosstalk results because the transmission circuit is split between two twisted pairs. The 610 reports a split pair when Near-end Crosstalk (NEXT) exceeds 21 dB (±3 dB) at 10 MHz.

Specifications

Cable Length: 0 to 122m (0 to 400 ft). Identifies opens, shorts, reversed or crossed pairs, and other miswires.
Split Pair Detection: Pairs are checked at 10 MHz and reported if crosstalk exceeds 21 dB ±3 dB
Input Connector: RJ-45
Input Protection: Inputs withstand telco ringing and loop voltages. Display alarms on overvoltage faults.

Environmental Requirements
Storage: -20°C to 60°C
Operating: 0°C to 50°C
Humidity: (Non-condensing) <95% to 30°C; <75% to 40°C; <45% to 50°C
Display: Single 16-segment character display; Four fault (red) LEDs; Four no fault (green) LEDs
Keyboard: One tactile-feedback momentary switch

Power
CableMapper: One 9V alkaline battery
Cable Identifier: None. Low power indication on the display.
Typical Battery Life: 1500 tests

Size
CableMapper: 3.5 cm H x 7.2 cm W x 9.4 cm L (1.3 in H x 2.8 in W x 3.7 in L)
Cable Identifier: 1.3 cm H x 2.8 cm W x 6.1 cm L (0.5 in H x 1.1 in W x 2.4 in L)

Weight
CableMapper: 0.18 kg (6.3 oz)
Cable Identifier: 0.02 kg (0.5 oz)

Warranty: One year

Ordering Information

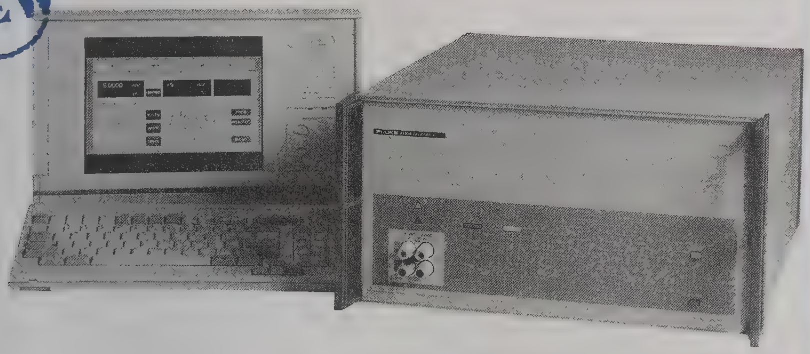
Model

610 LAN CableMapper

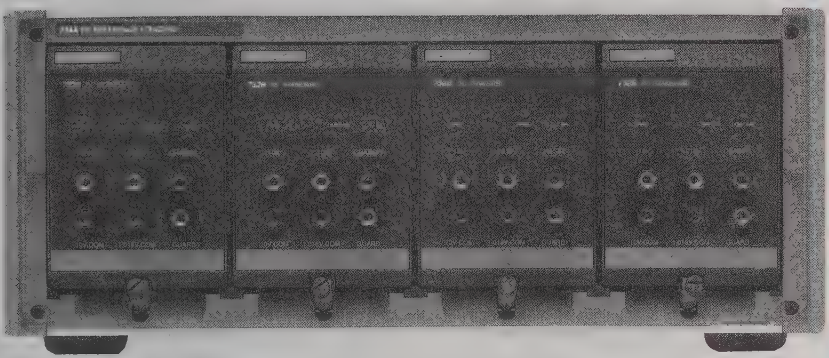
Included with Instrument
One Cable Identifier (#1), soft carrying case, user manual, warranty registration card, N6103 Cable Kit: One 24" RJ-45-to-RJ-45 straight through patch cable, two RJ-45-to-RJ-45 female couplers.

Optional Accessories
N6101 Cable Identifiers #2, #3, #4
N6102 Cable Identifiers #5, #6, #7, #8

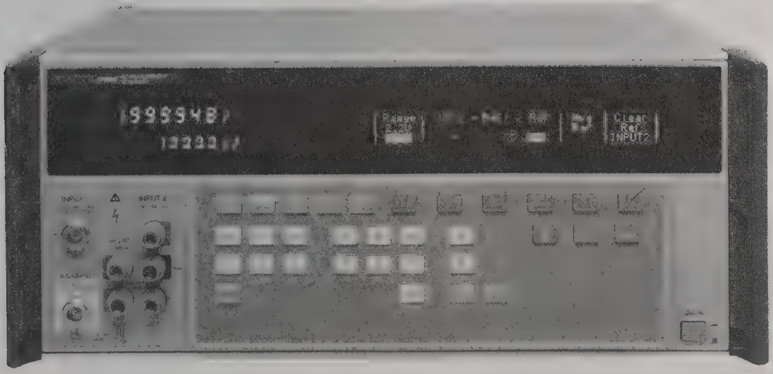
Calibration Instruments



5130A Page 229



734A Page 259



5790A Page 254

All electrical and electronic test and measurement instruments must be calibrated – when they are manufactured and at regular intervals to ensure accuracy and confidence in their measurements. Practically all instruments that measure voltage, current or resistance, can be calibrated with Fluke calibrators, standards, and auxiliary equipment.

In today's competitive marketplace, it's important to seize every possible advantage. The calibration hardware and software described on the following pages can contribute directly to product quality while controlling calibration expenses.

Selection Guides	Page 222
Calibration Instruments	Page 224
Automated Metrology	Page 246
Standards Instruments	Page 254

What is Calibration?

Calibration is a special, highly-refined process in which you compare an instruments performance with standards of known uncertainty to detect or correct any variation from required performance. In other words, it is a process verifying the operational integrity of instruments.

All electrical and electronic test and measurement instruments must be calibrated, both at the time of manufacture and at regular intervals during use, to assure the accuracy of and confidence in the measurements you make. You will often find that certification of calibration is a legal requirement, as exemplified in standards such as MIL-STD-45662A. And in today's quality-conscious environment, you will find that calibration plays a direct role in satisfying agressive quality standards such as ISO 9000.

Calibration provides two major benefits. First, it allows you to use your instruments with confidence by minimizing the uncertainties associated with your measurements. Second, it fulfills the requirements for "traceability" to national standards demanded so frequently today.

Fluke is the leader in dc and low frequency calibration. Fluke provides a broad range of products, from calibration instruments, to the standards required to maintain them, to Metrology Management Software. If you calibrate voltmeters, ohmmeters, ammeters, multimeters, oscilloscopes, or other electronic test and measurement instruments, Fluke has the calibration solutions to match your workload.

Fluke offers a wide range of single- and multi-function calibrators to cover the widest range of your calibration workload, as will the accessories and auxiliary productsyou need.

Fluke also offers the next logical step in calibration. Automated calibration software increases your productivity and repeatability, while easing your documentation process.

Finally, Fluke provides asset management software, to increase lab productivity and ease the pain of lab audits.

Fluke's commitment to the calibration market includes the support services you require. Applications support, training, traceability programs, maintenance, repair, calibration services, and module exchange programs you expect are all available from Fluke.

Study the Fluke calibration solutions on the following pages. If you need assistance, contact your Fluke Account Manager or call Fluke (toll free in the U.S.) at 800-44-FLUKE.

Calibrators

Model	Direct Voltage	Alternating Voltage	Direct Current	Alternating Current	Resistance	Wideband Voltage	Basic Uncertainty	IEEE-488	Page
5700A	To 1100V	To 1100V	To 2.2A	To 2.2A	1.0Ω to 100 MΩ	Option	5 ppm	Yes	224
5100B	To 1100V	To 1100V	To 2A	To 2A	1Ω to 10 MΩ	Option	40 ppm	Option	232
5101B	To 1100V	To 1100V	To 2A	To 2A	1Ω to 10 MΩ	Option	40 ppm	Option	232
5440B	To 1100V	—	—	—	—	—	3 ppm	Yes	235
5200A	—	To 120V	—	—	—	—	200 ppm	Option	237
343A	To 1100V	—	—	—	—	—	20 ppm	No	244
5450A	—	—	—	—	1.0Ω to 100 MΩ	—	8 ppm	Yes	240
515A	To 100V	To 100V	—	—	10Ω to 100 MΩ	—	30 ppm	No	269

Amplifiers

Model	Output Range	Compatible Calibrator	Gain Transcond	Page
5725A	1100V 1 to 11A AC/DC	5700A	—	224
5205A	1200V rms 1600V dc	5100B 5101B 5102B 5200A 5440B 5700A	100	241
5220A	1 to 20A	5100B 5101B 5102B 5440B 5700A	1A/V	243

AC/DC Current Shunts

Model	Current	AC/DC Difference	Frequency Range	Page
A40	10 mA to 5A	0.02% with 792A	5 Hz to 100 kHz	262
A40A	10A to 20A	0.03% with 792A	5 Hz to 50 kHz	262

Dividers and Standards Equipment

Model	Basic Uncertainty	Stability	Input Range	Page
752A	0.2 ppm - 10:1 0.5 ppm - 100:1	—	1100V	266
Y5020	±0.01%	0.002% in 6 months	0 to 20A	245
720A	0.1 ppm	1.0 ppm/yr	0 to 1100V	267
845AB	2%	0.15 μV/hr	1.0 μV to 1000V	268
845AR	3%	0.15 μV/hr	1.0 μV to 1000V	268

Reference Standards

Model	Uncertainty (Stability)	Direct Voltage	Alternating Voltage	Resistance	Frequencies	DVMP*	Page
734A	(0.3 ppm/month)	10V, 1.018V	—	—	—	Yes	259
732B	(0.3 ppm/month)	10V, 1.018V	—	—	—	Yes	259
792A	10 ppm/year	—	2 mV-1000V	—	10 Hz-1 MHz	No	260
5790A	24 ppm/year	—	700 μV-1000V		10 Hz-1 MHz	No	254
-03	0.5%/year	—	700 μV-7V		10 Hz-30 MHz	No	254
742A	(2.5 ppm/6 mo)	—	—	1Ω and 19 MΩ	—	No	263

**Direct Voltage Maintenance Program.*

Cost-Effective Solutions for Your Calibration Workload

While a calibrator's parts per million (ppm) specifications are important, focusing on specifications alone is not the best approach to selecting a calibration instrument. Other factors such as reliability, ease of use, expandability, service, and manufacturer service and responsiveness are equally as important as specifications. You need to consider the total cost of ownership.

Satisfying your calibration needs means far more than just buying some calibration hardware. Of course you need to look at the specifications, but make sure you are evaluating performance that fits your needs and not just paper promises.

The real challenge is how to get the most cost-effective workload coverage. Consider your population of instruments. Will you be calibrating ATE systems or handheld DMMs? How high is your volume?

To obtain sufficient workload coverage in the past, many different instruments were required to handle a single calibration task. Single instruments are now capable of multiple tasks. For example, when Fluke introduced the 5100 Series, it replaced the need for six different instruments and was dubbed the "cal lab in a box." With technology advances such as these, the expense of equipping a cal lab is decreasing. Now the 5700A provides still higher accuracy while maintaining compatibility with the 5100 Series.

You also need to keep the future in mind. Will you want to automate your calibration process at a later date? If so, consider calibration instruments that can be integrated into automated calibration systems.

A crucial aspect of achieving the best workload coverage is determining the level of accuracy required to calibrate instruments in your workload. For the most cost effective investment, concentrate on the instruments covering the greatest portion of your workload.

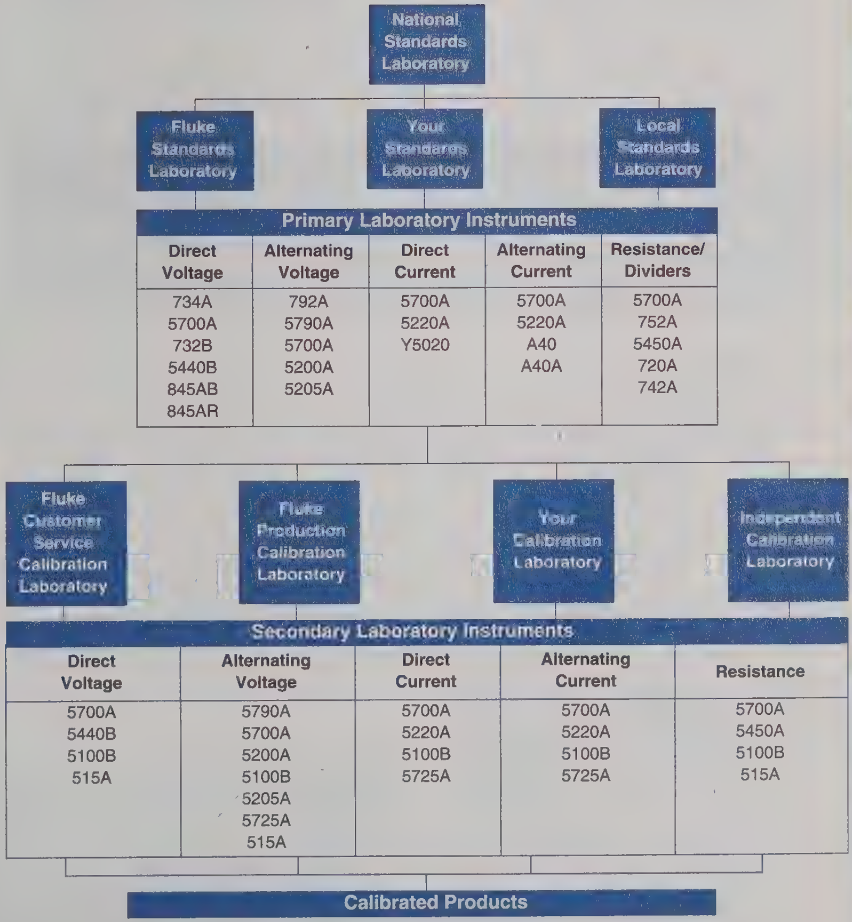
Using the Product/Applications Guide

The traceability chart shows you how Fluke calibration products cover your Calibration Lab and Standards Lab workload. This chart will help you select the instrumentation you need in your facility.

Find the position of your lab on the chart. Then refer to the box below for the appropriate products. Each product is fully described in the following pages. Your local Fluke Account Manager will be glad to assist you in matching Fluke instruments and systems to your requirements.

Selection Guide

Model	Multimeter Calibration	Direct Voltage Calibration	Alternating Voltage Calibration	Direct Current Calibration	Alternating Current Calibration	Resistance Calibration	Compatible Amplifiers
5700A	●	●	●	●	●	●	5725A, 5205A, 5220A
5100B	●	●	●	●	●	●	5205A, 5220A
5440B		●					5205A, 5220A
5200A			●				5205A
5450A						●	
515A	●	●	●			●	


National Standards Laboratory
Fluke Standards Laboratory
Your Standards Laboratory
Local Standards Laboratory

Primary Laboratory Instruments

Direct Voltage	Alternating Voltage	Direct Current	Alternating Current	Resistance/ Dividers
734A	792A	5700A	5700A	5700A
5700A	5790A	5220A	5220A	752A
732B	5700A	Y5020	A40	5450A
5440B	5200A		A40A	720A
845AB	5205A			742A
845AR				

Fluke Customer Service Calibration Laboratory
Fluke Production Calibration Laboratory
Your Calibration Laboratory
Independent Calibration Laboratory

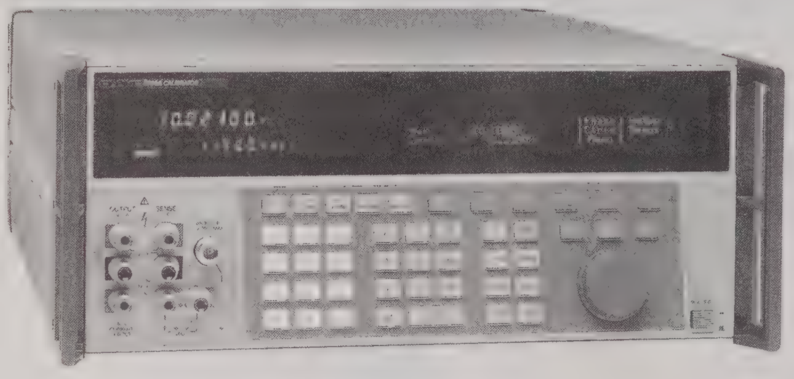
Secondary Laboratory Instruments

Direct Voltage	Alternating Voltage	Direct Current	Alternating Current	Resistance
5700A	5790A	5700A	5700A	5700A
5440B	5700A	5220A	5220A	5450A
5100B	5200A	5100B	5100B	5100B
515A	5100B	5725A	5725A	515A
	5205A			
	5725A			
	515A			

5700A

GPIB
IEEE-488

RS-232



5700A

5700A Calibrator

- Covers the complete DMM calibration workload
- Precision performance that is easy to use
- Simplified support with Artifact Calibration
- Compatible to protect your investment

Wide Workload Coverage

The Fluke 5700A is designed to cover the widest portion of today's calibration workload - a wide variety of DMMs from all manufacturers. It delivers direct voltage to 1100V and alternating voltage from 220 µV to 1100V at frequencies from 10 Hz to 1.2 MHz. Cardinal point resistances range from 1Ω to 100 MΩ in x1 and x1.9 decades, including a short. Direct and alternating current are provided to 2.2A, and frequencies for alternating current range from 10 Hz to 10 kHz.

One option is offered, wideband voltage (-03). It provides flat, low-noise alternating voltage output from 10 Hz to 30 MHz to extend workload coverage to include RF voltmeters. Output may be selected in volts or dBm referenced to 50Ω.

The companion 5725A Amplifier extends the 5700A's workload coverage still further. It increases maximum direct and alternating current to 11A for calibrating the high current ranges of popular low-cost and handheld DMMs. And it extends the calibrator's alternating volt-hertz product to 1100V at 30 kHz and 750V at 100 kHz to cover the calibration requirements of high-accuracy bench and system meters.

The 5700A is designed to be taken to the workload. In manufacturing applications, test instruments may be calibrated on-site, minimizing production line downtime due to calibration recall.

Low Cost of Ownership

The original purchase price is not the most significant cost associated with owning a high accuracy calibrator. Once the instrument is on the job, a wide range of calibration, maintenance, repair and training requirements increase its cost of ownership beyond the original purchase price many times over.

The 5700A Calibrator was designed to keep those traditional ownership costs down. Its powerful features are easy to use. Advanced internal metrology dramatically reduces support requirements while increasing your confidence in the instrument's performance. And its rugged, modular design increases reliability and makes problems easy to find and repair when they occur.

Simplified Calibration Support

Only three Artifact Standards, a 10V dc reference and 1Ω and 10 kΩ resistance references, are required to calibrate all 5700A ranges and functions to full specifications. The process, running under the control of the calibrator, takes about one hour. Instructions are displayed on the front panel in plain English to prompt the operator when to make various connections and inputs. For added confidence, Fluke recommends that a full verification of the 5700A be performed every two years or as required by your established procedures.

The 5700A does not need to be recalled to the standards laboratory for calibration. Due to its unique, environmentally tolerant design, the 5700A may be calibrated wherever it is used, at any temperature between 15°C and 35°C. Full performance is available for ±5°C of that temperature.

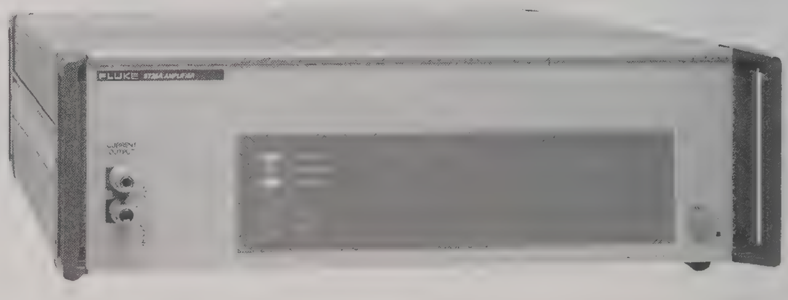
Complete Confidence

Between Artifact Calibrations, the 5700A's performance may be checked against its internal standards. Without adjusting the instrument, an automated procedure is available to check each range and function against internal check standards to increase your confidence that it is within performance tolerances. Should any range be shown to be out of specification, the operator is alerted. All results of this Cal Check process can be printed via RS-232C port. This data can be used to develop control charts to predict the long-term performance of the calibrator.

High Performance That's Easy to Use

In the past, calibration of precision DMMs required a host of complex, manually-operated instruments and standards.

The 5700A combines the functions of these instruments to dramatically simplify DMM calibration. Values are entered on the simple numeric keyboard and displayed on the front panel.



5725A

The command is confirmed with the ENTER key. To verify the reading of the UUT, the operator simply adjusts the output knob and the error is displayed directly in ppm or %. Output values can be selected for editing using the arrow keys. Using the OFFSET and SCALE keys, the 5700A compensates for meter zero offset and scale errors and directly displays linearity errors at any scale level. The x10 and ÷10 keys simplify work on meters requiring calibration levels in even decade steps. Just multiply or divide any output value by pressing the corresponding key.

To protect the operator and UUT, limits on maximum output can be preset. For additional operator protection, the 5700A resets to standby mode when output is increased to more than 22V.

Compatibility

The 5700A is designed to protect your investment in existing Fluke instruments and procedures. For example, a Fluke 5205A or voltage amplifier, and a Fluke 5220A transconductance amplifier may be connected directly to the 5700A through dedicated ports. In automated systems, the 5700A may be configured to emulate a 5100B so that existing procedures can be run with minimal modification.

Designed for Reliability

Another important factor in keeping instrument cost of ownership low is product reliability. Throughout its design and manufacture, the 5700A has been engineered to be the most reliable instrument of its type. Statistical process control techniques assure that quality is maintained, from component test through final assembly. Every 5700A is subjected to more than 2g of random vibration to prevent subtle imperfections from causing failures later on. A stiff chassis permits the 5700A to be moved with minimal risk of damage. Internal DIN connectors seal out potential environmental problems while keeping circuit boards firmly connected. Internal diagnostics exercise both digital and analog functions and can isolate problems to the board level, so repair often requires nothing more than the replacement of a plug-in module.

Specification Summary*

To simplify evaluation of how the 5700A covers your calibration workload, use the 5700A absolute uncertainty specifications.

**Complete 5700A and 5725 specifications are available. Ask for Fluke document A0296.*

Specifications

DC Voltage

Range	Resolution	Absolute Uncertainty: ±5°C from Calibration Temperature			
		24 Hours	90 Days	180 Days	1 Year
		±(ppm output + μV)			
220 mV	10 nV	6.5 + .75	7 + .75	8 + .75	9 + .8
2.2V	100 nV	3.5 + 1.2	6 + 1.2	7 + 1.2	8 + 1.2
11V	1 μV	3.5 + 3	5 + 4	7 + 4	8 + 4
22V	1 μV	3.5 + 6	5 + 8	7 + 8	8 + 8
220V	10 μV	5 + 100	6 + 100	8 + 100	9 + 100
1100V	100 μV	7 + 600	8 + 600	10 + 600	11 + 600

Resistance

Nominal Value	Absolute Uncertainty of Characterized Value ±5°C from Calibration Temperature			
	24 Hours	90 Days	180 Days	1 Year
Ω	±ppm			
0	50 μΩ	50 μΩ	50 μΩ	50 μΩ
1	85	95	100	110
1.9	85	95	100	110
10	26	28	30	33
19	24	26	28	31
100	15	17	18	20
190	15	17	18	20
1k	11	12	13	15
1.9k	11	12	13	15
10k	9	11	12	14
19k	9	11	12	14
100k	11	13	14	16
190k	11	13	14	16
1M	16	18	20	23
1.9M	17	19	21	24
10M	33	37	40	46
19M	43	47	50	55
100M	110	120	125	130

Absolute Uncertainty includes stability, temperature coefficient, linearity, line and load regulation, and the traceability of external standards. You do not need to add anything to determine the ratios between 5700A uncertainties and the uncertainties of your calibration workload.

Resistance

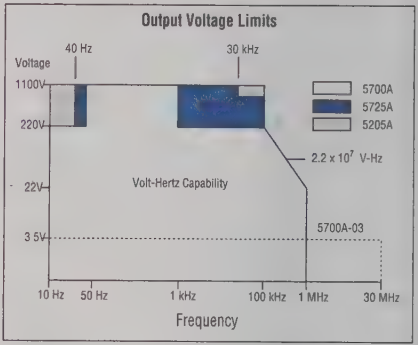
Seventeen passive resistance values are supplied in x1.0 and x1.9 multiples, plus a short to allow complete resistance calibration without moving test leads. Actual values assigned during calibration are displayed and used as reference points for error calculations.

For calibration of higher accuracy meters, 4-wire output connection is provided, with absolute uncertainties as shown in the table. Active 2-wire compensation is available for calibration of less accurate ohmmeters with 2-wire inputs. This feature substantially eliminates errors due to test lead resistance, and may be selected for resistance values up to 19 kΩ.

5700A

AC Voltage

Range	Resolution	Frequency	Absolute Uncertainty: ±5°C from Calibration Temperature			
			24 Hours	90 Days	180 Days	1 Year
		Hz	±(ppm output + µV)			
2.2 mV	1 nV	10-20	500 + 5	550 + 5	600 + 5	600 + 5
		20-40	200 + 5	220 + 5	230 + 5	240 + 5
		40-20k	100 + 5	110 + 5	120 + 5	120 + 5
		20k-50k	340 + 5	370 + 5	390 + 5	410 + 5
		50k-100k	800 + 8	900 + 8	950 + 8	950 + 8
		100k-300k	.11% + 15	.12% + 15	.13% + 15	.13% + 15
		300k-500k	.15% + 30	.17% + 30	.17% + 30	.18% + 30
		500k-1M	.30% + 30	.33% + 30	.35% + 30	.36% + 30
22 mV	10 nV	10-20	500 + 6	550 + 6	600 + 6	600 + 6
		20-40	200 + 6	220 + 6	230 + 6	240 + 6
		40-20k	100 + 6	110 + 6	120 + 6	120 + 6
		20k-50k	340 + 6	370 + 6	390 + 6	410 + 6
		50k-100k	800 + 8	900 + 8	950 + 8	950 + 8
		100k-300k	.11% + 15	.12% + 15	.13% + 15	.13% + 15
		300k-500k	.15% + 30	.17% + 30	.17% + 30	.18% + 30
		500k-1M	.30% + 30	.33% + 30	.35% + 30	.36% + 30
220 mV	100 nV	10-20	500 + 16	550 + 16	600 + 16	600 + 16
		20-40	200 + 10	220 + 10	230 + 10	240 + 10
		40-20k	95 + 10	100 + 10	110 + 10	110 + 10
		20k-50k	300 + 10	330 + 10	350 + 10	360 + 10
		50k-100k	750 + 30	800 + 30	850 + 30	900 + 30
		100k-300k	940 + 30	.1% + 30	.11% + 30	.11% + 30
		300k-500k	.15% + 40	.17% + 40	.17% + 40	.18% + 40
		500k-1M	.30% + 100	.33% + 100	.35% + 100	.36% + 100
2.2V	1 µV	10-20	500 + 100	550 + 100	600 + 100	600 + 100
		20-40	150 + 30	170 + 30	170 + 30	180 + 30
		40-20k	70 + 7	75 + 7	80 + 7	85 + 7
		20k-50k	120 + 20	130 + 20	140 + 20	140 + 20
		50k-100k	230 + 80	250 + 80	270 + 80	280 + 80
		100k-300k	400 + 150	440 + 150	470 + 150	480 + 150
		300k-500k	.10% + 400	.11% + 400	.12% + 400	.12% + 400
		500k-1M	.20% + 1 mV	.22% + 1 mV	.23% + 1 mV	.24% + 1 mV
22V	10 µV	10-20	500 + 1 mV	550 + 1 mV	600 + 1 mV	600 + 1 mV
		20-40	150 + 300	170 + 300	170 + 300	180 + 300
		40-20k	70 + 70	75 + 70	80 + 70	85 + 70
		20k-50k	120 + 200	130 + 200	140 + 200	140 + 200
		50k-100k	230 + 400	250 + 400	270 + 400	280 + 400
		100k-300k	500 + 1.7 mV	550 + 1.7 mV	550 + 1.7 mV	600 + 1.7 mV
		300k-500k	.12% + 5 mV	.13% + 5 mV	.13% + 5 mV	.14% + 5 mV
		500k-1M	.26% + 9 mV	.28% + 9 mV	.29% + 9 mV	.30% + 9 mV
			±(ppm output + mV)			
220V	100 µV	10-20	500 + 10	550 + 10	600 + 10	600 + 10
		20-40	150 + 3	170 + 3	170 + 3	180 + 3
		40-20k	75 + 1	80 + 1	85 + 1	90 + 1
		20k-50k	200 + 4	220 + 4	240 + 4	250 + 4
		50k-100k	500 + 10	550 + 10	600 + 10	600 + 10
		100k-300k	.15% + 110	.15% + 110	.16% + 110	.16% + 110
		300k-500k	.50% + 110	.52% + 110	.53% + 110	.54% + 110
		500k-1M	1.20% + 220	1.25% + 220	1.25% + 220	1.30% + 220
1100V	1 mV	50-1k	75 + 4	80 + 4	85 + 4	90 + 4



AC Voltage, 5725A Amplifier

Range	Resolution	Frequency	Absolute Uncertainty: ±5°C from Calibration Temperature			
			24 Hours	90 Days	180 Days	1 Year
		Hz	±(ppm output + mV)			
1100V	1 mV	40-1k	75 + 4	80 + 4	85 + 4	90 + 4
		1k-20k	105 + 6	125 + 6	135 + 6	165 + 6
		20k-30k	230 + 11	360 + 11	440 + 11	600 + 11
750V		30k-50k	230 + 11	360 + 11	440 + 11	600 + 11
		50k-100k	600 + 45	.13% + 45	.16% + 45	.23% + 45

Current

The 5700A supplies direct alternating current to 2.2A, extended to 11A with the 5725A Amplifier or to 20A with the 5220A Transconductance Amplifier. 5700A current output is available on front or rear voltage output terminals. For convenience in calibrating meters with separate current terminals, 5700A outputs may also be directed either to an auxiliary front panel current terminal or to 5725A front or rear terminals. This allows automated meter calibration without moving test leads.

For system applications, a rear panel current guard provides a voltage follower output for guarding low level current through longer system cables.

DC Current

Range	Resolution	Absolute Uncertainty: ±5°C from Calibration Temperature			
		24 Hours	90 Days	180 Days	1 Year
	nA	±(ppm output + nA)			
220 µA	.1	45 + 10	50 + 10	55 + 10	60 + 10
2.2 mA	1	45 + 10	50 + 10	55 + 10	60 + 10
22 mA	10	45 + 100	50 + 100	55 + 100	60 + 100
	µA	±(ppm output + µA)			
220 mA	.1	55 + 1	60 + 1	65 + 1	70 + 1
2.2A	1	75 + 30	80 + 30	90 + 30	95 + 30
5725A Amplifier:					
11A	10	330 + 470	340 + 480	350 + 480	360 + 480

AC Current

Range	Resolution	Frequency	Absolute Uncertainty: ±5°C from Calibration Temperature			
			24 Hours	90 Days	180 Days	1 Year
		Hz	±(ppm output + nA)			
220 µA	1 nA	10-20	650 + 30	700 + 30	750 + 30	800 + 30
		20-40	350 + 25	380 + 25	410 + 25	420 + 25
		40-1k	120 + 20	140 + 20	150 + 20	160 + 20
		1k-5k	500 + 1 µA	600 + 1 µA	650 + 1 µA	700 + 1 µA
		5k-10k	.15% + 4 µA	.16% + 4 µA	.17% + 4 µA	.18% + 4 µA
2.2 mA	10 nA	10-20	650 + 50	700 + 50	750 + 50	800 + 50
		20-40	350 + 40	380 + 40	410 + 40	420 + 40
		40-1k	120 + 40	140 + 40	150 + 40	160 + 40
		1k-5k	500 + 2 µA	600 + 2 µA	650 + 2 µA	700 + 2 µA
		5k-10k	.15% + 4 µA	.16% + 4 µA	.17% + 4 µA	.18% + 4 µA
22 mA	100 nA	10-20	650 + 500	700 + 500	750 + 500	800 + 500
		20-40	350 + 400	380 + 400	410 + 400	420 + 400
		40-1k	120 + 400	140 + 400	150 + 400	160 + 400
		1k-5k	500+10 µA	600+10 µA	65+10 µA	700+10 µA
		5k-10k	.15%+20 µA	.16%+20 µA	.17%+20 µA	.18%+20 µA
		Hz	±(ppm output + µA)			
220 mA	1 µA	10-20	650 + 5	700 + 5	750 + 5	800 + 5
		20-40	350 + 4	380 + 4	410 + 4	420 + 4
		40-1k	120 + 4	150 + 4	170 + 4	180 + 4
		1k-5k	500 + 50	600 + 50	650 + 50	700 + 50
		5k-10k	.15% + 100	.16% + 100	.17% + 100	.18% + 100
2.2A	10 µA	40-1k	600 + 40	650 + 40	700 + 40	750 + 40
		1k-5k	700 + 100	750 + 100	800 + 100	850 + 100
		5k-10k	.80% + 200	.90% + 200	.95% + 200	1.0% + 200
5725A Amplifier:						
11A	100 µA	40-1k	370 + 170	400 + 170	440 + 170	460 + 170
		1k-5k	800 + 380	850 + 380	900 + 380	950 + 380
		5k-10k	.3% + 750	.33% + 750	.35% + 750	.36% + 750

Wideband AC Voltage Option (-03)

Specifications apply to the end of the cable and 50Ω termination used for calibration:

Range		Resolution	Absolute Uncertainty: ±5°C from Calibration Temperature 30 Hz-500 kHz			
Volts	dBm		24 Hours	90 Days	180 Days	1 Year
			±(% output + µV)			
1.1 mV	-46	10 nV	.4 + .4	.5 + .4	.6 + .4	.8 + 2
3 mV	-37	10 nV	.4 + 1	.45 + 1	.5 + 1	.7 + 3
11 mV	-26	100 nV	.2 + 4	.35 + 4	.5 + 4	.7 + 8
33 mV	-17	100 nV	.2 + 10	.3 + 10	.45 + 10	.6 + 16
110 mV	-6.2	1 µV	.2 + 40	.3 + 40	.45 + 40	.6 + 40
330 mV	+3.4	1 µV	.2 + 100	.25 + 100	.35 + 100	.5 + 100
1.1V	+14	10 µV	.2 + 400	.25 + 400	.35 + 400	.5 + 400
3.5V	+24	10 µV	.15 + 500	.2 + 500	.3 + 500	.4 + 500

Frequency	Frequency Resolution	Amplitude Flatness, 1 kHz Reference		
		Voltage Range		
		1.1 mV	3 mV	>3 mV
Hz	Hz	±%		
10-30	.01	.3	.3	.3
30-120	.01	.1	.1	.1
120-1.2k	.1	.1	.1	.1
1.2k-12k	1	.1	.1	.1
12k-120k	10	.1	.1	.1
120k-1.2M	100	.2 + 3 µV	.1 + 3 µV	.1 + 3 µV
1.2M-2M	100k	.2 + 3 µV	.1 + 3 µV	.1 + 3 µV
2M-10M	100k	.4 + 3 µV	.3 + 3 µV	.2 + 3 µV
10M-20M	1M	.6 + 3 µV	.5 + 3 µV	.4 + 3 µV
20M-30M	1M	1.5 + 15 µV	1.5 + 3 µV	1 + 3 µV

Additional Operating Information: dBm reference = 50Ω
Range boundaries are at voltage points, dBm levels are approximate

$$\text{dBm} = 10 \log \left(\frac{\text{Power}}{1\ \text{mW}} \right),$$

for 50Ω: 0 dBm = 1 mW across 50Ω = 0.22361V
Minimum Output: 300 µV (-57 dBm)
Frequency Uncertainty: ±0.01%
Overload Protection: A short circuit on the wideband output will not result in damage. After settling time, normal operation is restored upon removal.

General Specifications

Warm-up Time: 2x the time since last warmed up, to a maximum of 30 minutes
System Installation: Rear output configuration and rack mount kit available
Standard Interfaces: IEEE-488, RS-232C, 5725A, 5205A or 5215A, 5220A, phase lock in (BNC), phase reference out (BNC)
Temperature Performance: Operating: 0°C to 50°C. Calibration: 15°C to 35°C. Storage: -40°C to 75°C. Tested for compliance with MIL-T-28800D, para. 4.5.5.1.1, Class 5.
Relative Humidity: Operating: <90% to 30°C, <70% to 40°C, <40% to 50°C. Storage <95%, non-condensing. Tested for compliance with MIL-T-28800D, para. 4.5.5.1.1, Class 5.
Safety: Designed to comply with UL 1244 (1987); IEC 348-1978l IEC 1010, CSA 556B, and ANSI/ISA-582
Guard Isolation: 20V
EMI/RFI: Designed to comply with FCC Rules Part 15, Subpart J, Class B; VDE 0871, Class B
Vibration: Tested for compliance with MIL-T-28800D, para. 4.5.5.3.1, Class 5

5700A

All ranges and functions of the 5700A, 5725A and Wideband Voltage option may be calibrated using just three Artifact Standards.

Physical Shock: Tested for compliance with MIL-T-2800C, para. 4.5.5.4.1, Class 5
Reliability: MIL-T-28800D, para. 3.13.3
Line Power: 47 to 63 Hz; ±10% allowed about selectable nominal line voltage: 100V, 110V, 115V, 120V, 200V, 220V, 230V, 240V
Maximum Power: 5700A, 300 VA; 5725A, 750 VA

Size

5700A: Height 17.8 cm (7 in), standard rack increment, plus 1.5 cm (0.6 in) for feet; width 43.2 cm (17 in), standard rack width; depth 63.0 cm (24.8), overall; 57.8 cm (22.7 in), rack depth
5725A: Height 13.3 cm 5.25 in); width and depth same as 5700A; both units project 5.1 cm (2 in) from rack front
Weight: 5700A: 27 kg (62 lb); 5725A: 32 kg (70 lb)

Calibration Requirements

Calibrating the 5700A to full specified absolute uncertainty requires only the following standards:

Fluke Standard	Traceable Quantity	Nominal Value	Uncertainty*
732B	Voltage	10V	±1.5 ppm
742A-1	Resistance	1Ω	±10 ppm
742A-10k	Resistance	10 kΩ	±4 ppm

**Relative to national standards*

The 5700A's simple, built-in, self-prompting calibration procedure is designed to use the portable Fluke standards to completely calibrate all of its functions.

Calibration may be done at any temperature from 15°C to 35°C without change to any specification except for resistance. Resistance specifications are modified by a small temperature coefficient when the 5700A is calibrated below 19°C or above 24°C.

You may use standards with different uncertainties than given in the table at left. Absolute uncertainty must then be modified by the algebraic difference between the uncertainty of the standard used and that in the table. For example if the dc voltage standard has an uncertainty of ±2.5 ppm, 5700A dc voltage absolute uncertainty specifications will all be increased by ±1 ppm. Note that dc and ac current specifications include the uncertainties of both the dc voltage and resistance standards that are used.

Ordering Information

Models

5700A Calibrator
5700A-01 Calibrator, Rear Output Option*
5725A Amplifier
5725A-01 Amplifier, Rear Output Option*

**Factory installed only*

Included with Instrument
One-year product warranty, line cord, getting started manual, operator manual and service manual.

Option
5700A-03 Wideband AC Voltage

Accessories (Also see Section 19)
5440A-7002 Low Thermal Cable Set
5700A-7002 Portable Artifact Cal Package
Includes 732B DC Standard, 742A-1 and 742A-10K Resistance Standards, 732B-7001 External Battery and Charger, 52 Digital Thermometer, 5440A-7002 Test Leads in a rugged shipping case
732B DC Voltage Reference Standard
742A-1 1Ω Resistance Standard
742A-10k 10 kΩ Resistance Standard
Y5701 Cable for 5205A or 5215A
Y5702 Cable for 5220A
Y5737 Rack Mount Kit with 24" slides for 5700A*
Y5735 Rack Mount Kit with 24" slides for 5725A*
Y8021 Shielded IEEE-488 Cable, 1m
Y8022 Shielded IEEE-488 Cable, 2m
Y8023 Shielded IEEE-488 Cable, 4m

**These rack slides allow for side ventilation*

Manuals
5700A Operator*
5700A Getting Started*
5700A Quick Reference Guide
5700A IEEE-488 Reference Guide
5700A Service*
5725A Instruction*

**No charge with purchase of unit*

Customer Support Services

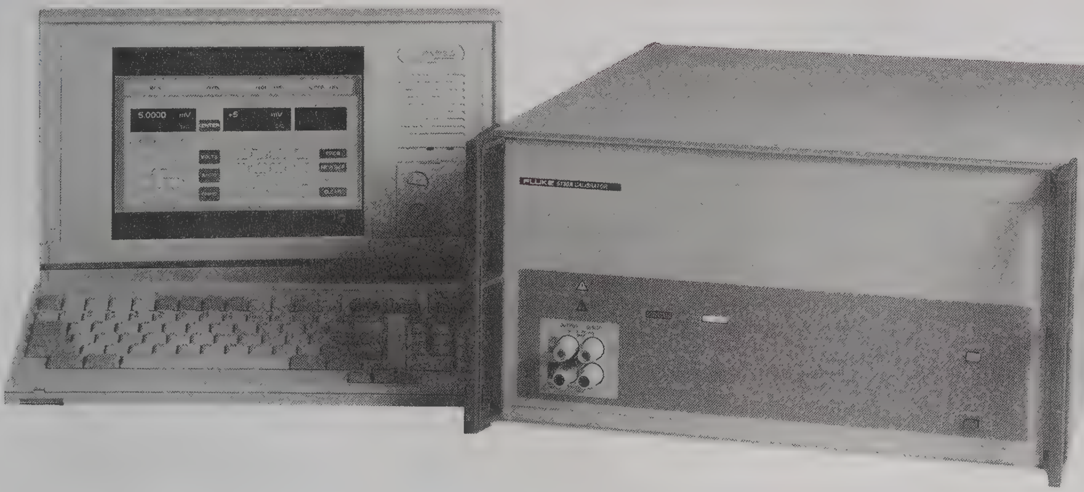
Also see Section 20.

Factory Warranty
One-year product warranty.

5130A

GPIB
IEEE-488

RS-232



5130A

5130A Calibration Workstation

- Cost effective automated meter calibration system
- Includes calibration, data management and front panel software and accessories
- Designed to meet the calibration requirements of quality standards like ISO 9000
- Five functions: direct and alternating voltage and current, and resistance
- Compatible with 5205A and 5220A amplifiers to boost voltage and current

The 5130A is a turn-key, automated meter calibration system designed to help smaller calibration departments meet the calibration requirements of international quality standards like ISO 9000. It consists of application software that simplifies and automates management, control and documentation of all facets of the calibration process, and a five function calibrator that provides traceability to national standards. With the 5130A, you may create and run calibration procedures, keep records on test results, standards used and traceability, and report on measurement asset status, recall, calibration history and location.

Automated Calibration and Results Data Collection with 5130/CAL

5130/CAL is based on the Fluke's popular MET/CAL software. With it you can create test procedures and execute them under computer control. With minimal training, operators can complete even complex calibrations quickly and consistently time after time. And complete results are collected automatically during every test. More than 90 procedures covering a wide range of meters are included, and you can use them as is or as a guide for your own procedures.

5130/CAL also maintains system specification and traceability information so that you can ensure that tests are adequate and documented. Results and certificates can be printed on a printer or saved in disk files.

Integration with 5130/TRACK is simple and virtually seamless. Use 5130/TRACK to compile a workload list. Calibrate the workload with 5130/CAL, then send the results to 5130/TRACK to update your calibration data base.

Data Management and Control with 5130/TRACK

5130/TRACK is a comprehensive data management and reporting application for the PC based on popular MET/TRACK. Unlike most data management systems, 5130/TRACK is designed around the special requirements of the calibration operation. Assets are added to the inventory, calibrated, returned to their owners and recalled as needed. All along the way, you may access and report on a wide variety of information through on-line searches or reports.

5130/TRACK permits you to control, manage and report on location, use, calibration and traceability of every measurement asset in your inventory. Up to five levels are security are available to assure that only the right people have access to your system. Validation speeds up manual data entry and assures consistency. And transferring information to and from existing business systems is easily accomplished.

A key feature of 5130/TRACK is its ability to control and report on the traceability of all of your measurement instruments. 5130/TRACK lets you assign a hierarchy of standards to assure adequacy and reports on the traceability of your instruments, forward from a specific instrument to national standards and the reverse from a specific instrument to every asset affected.

More than 90 report formats are included for virtually any information you might need. Use them as is or customize them to fit your specific needs.

Simple Manual Operation Through Virtual Front Panel (VFP) Software

VFP software makes quick manual or semi-automatic operation easy. Fashioned after a traditional hardware front panel, you may operate it using the computer keyboard, mouse or a combination. Up to 20 front panel set-ups may be saved in a file, permitting you to create short procedures. The VFP also lets you set output limits to protect equipment and operators, or to chose to display unit under test error in units, ppm and ratio.

Wide Workload Coverage

The 5130A Calibrator is based on the world's most popular multifunction meter calibrator, the 5100B Series. It is designed to cover a large portion of your meter workload, analog and digital multimeters up to 4.5 digits. It outputs direct voltage from 0 to ±1100V. Direct current from 0

5130A

±2A, alternating voltage from 20 mV to 1100V over a frequency range of 10 Hz to 50 kHz, and resistance in decade steps from 1Ω to 10 MΩ.

The 5130A Calibrator is fully compatible with 5205A and 5220A amplifiers to boost voltage and current capability. High voltage loading may be extended from 6 mA maximum to 100 mA at 1100V for direct voltage. Alternating volt-Hertz limits may be extended from 20V at 50 kHz to 1100V at 50 kHz. Current may be extended from 2A to 20A.

A Y5000 Interface Buffer and cable are required to integrate a 5205A and/or 5220A with the 5130A. It connects to the rear panel. The amplifiers are still controlled by the VFP or 5130/CAL.

Specifications

Technical Specifications

Direct Voltage

Range	Resolution	Maximum Current	Ripple and Noise (10 Hz to 3 kHz, NL to FL, RMS)
20 mV	0.1 µV	Limited by 50Ω output resistance or 25 mA using 50Ω overide	0.01 of setting +25 µV**
200 mV	1 µV		
2V	10 µV		
20V	100 µV	25 mA 1000 pF	0.02% of setting + 50 µV
200V	1 mV	10 mA/ 400 pF*	0.05% of setting (open to 20 kΩ) 0.1 of setting (20 kΩ to full load)
1100V	10 mV	6 mA/ 400 pF*	0.05% of setting

**100 mA/1500 pF with 5205A, Y5000 and Y5001*
***Double both terms for divider override mode*

Uncertainty: ±(0.004% of setting +0.001% of range +5 µV) for all ranges, for 6 months, 20°C to 30°C ambient, non-override; ±(0.005% of setting +0.2 mV) for divider override mode. ±(0.07% of setting +20 mV) for voltages from ±(100V to 1100V) using the 5205A Power Amplifier
Temperature Coefficient: Above 30°C and below 20°C, ±(5 ppm of setting +1 ppm of range +1 µV)/°C to 200V, ±(5 ppm of setting +2 ppm of range)/°C, 200V to 1100V
Short Term Stability: (For 10 minutes from 0°C to 50°C) ±(10 ppm of setting +2 ppm of range +5 µV) to 500V; ±25 ppm of setting, 500V to 1100V
Load Regulation: External Sense, ±10 ppm from 2V to 1100V, no-load to full-load; Internal, Sense same as external except full-load is 400Ω

Alternating Voltage

Range*	Resolution	Maximum Load	Total Harmonic Distortion and Noise
20 mV	0.1 µV	Limited by 50Ω output resistance	Bandwidth of 10 Hz to 200 kHz, Distortion, line interference + noise including random spikes **20V and Higher** 50 Hz to 10 kHz: 0.08% of output rms **Below 20V** 50 Hz to 10 kHz: (0.05% of output + 10 µV) rms 10 kHz to 50 kHz: (0.08% of output + 20 µV) rms
200 mV	1 µV		
2V	10 µV	2 kΩ/ 1000 pF	
20V	100 µV	25 mA/ 1000 pF	
200V	1 mV	10 mA/ 400 pF	
1100V	10 mV	6 mA/ 400 pF**	

** Can be set in dBm where 0 dBm + 1 mW in 6008 + 0.7746V*
***200 mA/1500 pF with 5205A, Y5000 and Y5001*

Uncertainty: ±(0.035% of setting +0.005% of range +50 µV) from 50 Hz to 10 kHz and ±(0.06% of setting +0.008% of range +50 µV) from 10 kHz to 50 kHz for 6 months, 20°C to 30°C ambient. ±(0.08% of setting +.1V) for voltages from ±(100V to 1100V) and frequencies from 50 Hz to 10 kHz and ±(0.12% of setting +0.15V) for frequencies from 10 kHz to 50 kHz using the 5205A Power Amplifier
Frequencies Available (Hz): 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600, 700, 800, and 900 for all voltage ranges

Frequencies Available (kHz):

Voltage Range	1	2	3	4	5	6	7	8	9	10	20	30	40	50
110V to 1100V	•	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
20V to 110V	•	•	•	•	•	•	•	•	•	•	•	Δ	Δ	Δ
1 mV to 20V	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Δ With 5205A, Y5000, and Y5001

Frequency Uncertainty: ±3%
Temperature Coefficient: Above 30°C and below 20°C ±(20 ppm of setting +2 ppm of range)/°C for amplitude, ±0.1%/°C for frequency
Short Term Stability: ±(0.01% of range +10 µV) for 10 minutes from 0°C to 50°C
Load Regulation: External Sense, ±200 ppm from 0.2V to 1100V, no-load to full-load; Internal Sense, same as external except regulation for voltages <0.2V is expressed as an output impedance of 50Ω

Direct Current

Range	Resolution	Compliance Voltage	Ripple and Noise
200 µA	1 nA	0 to 10V	(0.05% of output +0.01 µA) rms Measured with 10 Hz to 10 kHz bandwidth including random spikes
2 mA	10 nA		
20 mA	100 nA		
200 mA	1 µA		
2A*	10 µA	0 to 2.1V	

**20A with 5220A, Y5000, and Y5002*

Uncertainty: ±0.015% of setting +0.002% of range +0.01 µA) for compliance voltage up to 1V. Add 0.002% of setting per volt above 1V rms, applies for 6 months and 20°C to 30°C ambient. ±(0.025% of setting +1 mA) for currents from ±(1A to 20A) using the 5220A Transconductance Amplifier
Temperature Coefficient: Above 30°C and below 20°C ±(10 ppm of setting +2 ppm of range)/°C
Short Term Stability: ±(50 ppm of setting +5 ppm of range +0.002 µA) for 10 minutes from 0°C to 50°C
Load Regulation: ±20 ppm/volt for change in output voltage from 1 volt to maximum compliance voltage

Alternating Current

Range	Resolution	Compliance Voltage	Total Harmonic Distortion & Noise
200 µA	1 nA	0 to 7V	(0.05% of output +0.01 µA) rms Measured with 10 Hz to 10 kHz bandwidth including random spikes
2 mA	10 nA		
20 mA	100 nA		
200 mA	1 µA		
2A*	10 µA	0 to 1.4V	

**20A with 5220A, Y5000, and Y5002*

Uncertainty: ±0.05% of setting +0.005% of range +0.02 µA) for compliance voltage up to 1V rms (50 Hz to 1 kHz). Add 0.005% of setting per volt above 1V rms. Applies for 6 months in 20°C to 30°C ambient. ±(0.07% of setting +1 mA) for currents from ±(1A to 20A) and frequencies from 50 Hz to 1 kHz and ±(0.07% of setting +1 mA)* (frequency in kHz) for frequencies from 1 kHz to 5 kHz using the 5220A Transconductance Amplifier
Temperature Coefficient: Above 30°C and below 20°C ±(25 ppm of setting +10 ppm of range +0.2 nA)/°C for amplitude, +0.1%/°C for frequency
Short Term Stability: ±(0.014% of setting +0.002% of range +0.4 µA) for 10 minutes from 0°C to 50°C
Load Regulation: ±(50 ppm +20 nA)/volt for change in output voltage from 1 volt to maximum compliance voltage

Resistance

Range: 1Ω to 10 MΩ in decade steps
Uncertainty: ±0.003%, except ±0.015% (1Ω), ±0.010% (10Ω and 1 MΩ), and ±0.030% (10 MΩ) assumes 4 terminal below 100 kΩ, applies for 6 months 20°C to 30°C ambient
Power Dissipation: 1W maximum except 100 mW max (1 MΩ) and 10 mW max (10 MΩ)
Temperature Coefficient: Above 30°C and below 20°C, ±5 ppm/°C except ±10 ppm/°C (1Ω and 10Ω), ±10 ppm/°C up to 40°C (10 MΩ), and ±50 ppm/°C above 40°C (10 MΩ)

General Specifications

Shock and Vibration: Meets requirements of MIL-T-28800 for Class 5, Style E equipment
Temperature: 0°C to 50°C operating; -20°C to +65°C non-operating
Relative Humidity: 85% to 35°C, ≤70% to 40°C, ≤50% to 50°C
Power: 100, 110, 115, 120, 200, 220, 230, 240V ac, switch-selectable ±10%, 50 Hz to 60 Hz; 200 VA

Mechanical Data

Size: 22.2 cm H x 60.3 cm W x 43.2 cm L (8.75 in H x 17 in W x 23.75 in L)
Weight: 30.4 kg (67 lb) basic, 32.7 kg (72 lb)

Ordering Information

Models

5130A Calibration Workstation
5205A* Power Amplifier
5220A* Transconductance Amplifier

**Y5001 or Y5002 cable and Y5000 interface required when used with 5130 Calibration Workstation*

Included with Instrument

One-year product warranty, line cord, manuals, and Certificate of Calibration.

Accessories (Also see Section 19)

5100A-7005K Extender Kit
M08-205-600 8³/₄" Rack Mount Kit, 5100B/5101B
M00-280-610** 24" Rack Slides
Y5000 Interface Buffer for 5205A, and 5220A
Y5001 Interface Cable for 5205A and Y5000
Y5002 Interface Cable for 5220A and Y5000

Manuals

5205A Instruction*
5220A Instruction*

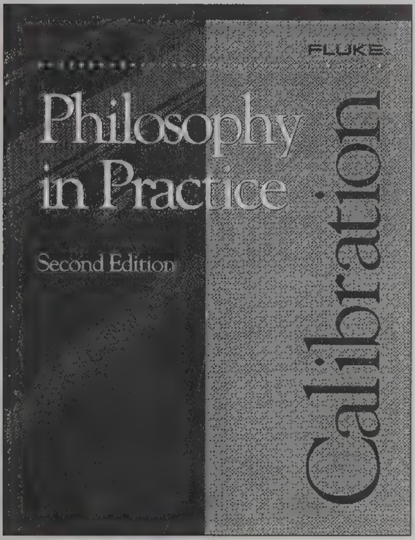
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty

One-year product warranty.



2nd Edition

EW

Calibration: Philosophy and Practice Second Edition

- The only comprehensive text book on dc/lf metrology
- Hardbound, more than 400 pages
- An easy to use source for the new technician or the seasoned metrologist
- Includes coverage on the impact of ISO 9000 and other quality standards

The second edition of Calibration: Philosophy and Practice is a complete and thorough update of the only comprehensive textbook on dc/low frequency metrology.

It covers real world concepts and applications and is designed and written for the working technician and contains clear descriptions of all concepts and generous use of photos and diagrams to help illustrate subjects.

Calibration: Philosophy and Practice covers the entire subject of dc/lf metrology. Subjects include:

Elements of Metrology
- International system of units (SI)
- Standards and traceability
- Lab operation and environment
- ISO 9000 and other quality standards

Primary and Secondary Standards
- AC, DC, voltage and current, resistance, ratio, capacitance, inductance, immitance and time and frequency

Calibrators and Calibration
- Meters
- Scopes
- Artifact Calibration
- Automation

Statistics and Specifications
- Application of statistics in metrology
- Interpreting instrument specifications
- Statistical Process Control

Laboratory Management
- Environment
- Workload management
- Selecting new equipment
- Lab accreditation
- Audits

Practical Considerations
- Guarding and grounding
- Parasitics

Full index, comprehensive glossary, and more.

Calibration: Philosophy and Practice is both an excellent training guide for new technicians as well as a reference tool for the working technician, engineer or metrologist. No calibration or service lab should be without one.

Ordering Information

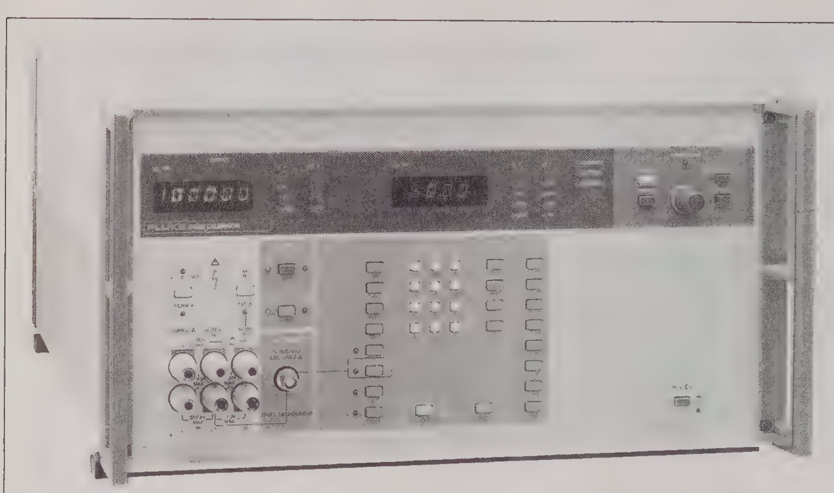
Calibration: Philosophy and Practice*

**Quantity discounts are available*

5100B Series

GPIB
IEEE-488

RS-232



(NSN 6625-01-099-2414) **5100B**

5100B Series Calibrators

- Continuously improved version of the world's most popular multifunction calibrator
- Cost-effective multimeter calibration to 4½ digits
- Five functions: Direct or alternating voltage or current plus resistance
- Modern production methods offer superior quality
- Unique cassette tape drive option available for storing procedures
- Compatible with MET/CAL based systems, 5700A Calibrator, 5205A Power Amplifier, and 5220A Transconductance Amplifier

The 5100B Series Calibrators are the world's leading calibrators for analog and digital multimeters to 4½ digits. Dependability, five-function versatility and cost effectiveness have made the 5100B Series Calibrators basic equipment for nearly every calibration laboratory.

DC voltage uncertainty is 40 ppm; basic ac uncertainty is 350 ppm. The front panel includes high-voltage safety terminals together with control grouping optimized for user friendliness. Quality and reliability are also enhanced with modern manufacturing methods including statistical process control (SPC).

The versatility of the 5100B Series Calibrators is unmatched at any price. They are compatible with the MET/CAL based Automated Calibration Systems, the Navy's MECCA Systems and the Fluke 5700A Multifunction Calibrator. Enhanced capability is also available with the 10 MHz Wideband Option and the capability to directly drive the Fluke 5220A 20A Transconductance Amplifier and the 5205A Precision Power Amplifier.

5100B Series Increases Throughput

Operating the 5100B Series is simple, making it easy to train your operators. And all data is entered via a calculator-type keyboard. No need to convert volts to dBm or dBm to volts, for example. And the 5100B Series performs the mathematical computations associated with calculating the error of the unit-under-test (UUT) – in % or in dB. It then indicates to the operator whether the UUT passed or failed, according to its specified uncertainty and the magnitude of the error.

5101B Has System Features

The 5101B is designed for the user who needs the automated features of a large computer-aided calibration system without the hardware and software costs of a large system.

A typical calibration procedure consists of forty or fifty separate steps. For most benchtop systems, each step must be loaded into the calibrator – an operation that is slow and prone to human error. The 5101B has a built-in cassette tape deck to store calibration procedures and step through them under microprocessor control.

Initially, the operator records the procedure on a mini-cassette. Once recorded, the procedure can be repeated in a fraction of the usual time. Preparing the calibration tape and operating the 5101B requires no special knowledge of computers or computer languages. Using a printer and interface option with the 5101B, you can document both the calibration procedure and the test results with a hard-copy record.

Extended Power and Current Capabilities

The 5205A Precision Power Amplifier and the 5220A Transconductance Amplifier will operate as an integrated system with either a 5100B, 5101B, or 5102B. The purpose is to extend the voltage and current sourcing capabilities beyond the basic built-in capabilities of the 5100B Series Calibrators.

High voltage loading may be extended from 6 mA maximum to 100 mA maximum at 1100V for direct voltage. And alternating volt-hertz limits may be extended from 20V at 50 kHz to 1100V at 50 kHz. Current sourcing may be extended from 2A to 20A.

A Y5000 Interface Buffer is needed to integrate a 5205A and/or a 5220A with 5100B Series. It connects to the rear panels and preserves the advantage of single-point control of calibration, automatic error calculation, entry limit protection, etc. The system is operated and controlled using only the front panel of the 5100B/5101B or procecures stored on a 5101B mini-cassette.

Specifications

Technical Specifications

Direct Voltage

Range	Resolution	Maximum Current	Ripple and Noise (10 Hz to 3 kHz, NL to FL, RMS)
20 mV	0.1 µV	Limited by 50Ω output resistance or 25 mA using 50Ω overide	0.01 of setting +25 µV**
200 mV	1 µV		
2V	10 µV		
20V	100 µV	25 mA 1000 pF	0.02% of setting + 50 µV
200V	1 mV	10 mA/ 400 pF*	0.05% of setting (open to 20 kΩ) 0.1 of setting (20 kΩ to full load)
1100V	10 mV	6 mA/ 400 pF*	0.05% of setting

**100 mA/1500 pF with 5205A, Y5000 and Y5001*
***Double both terms for divider override mode*

Uncertainty: ±(0.004% of setting +0.001% of range +5 µV) for all ranges, for 6 months, 20°C to 30°C ambient, non-override; ±(0.005% of setting +0.2 mV) for divider override mode
Temperature Coefficient: Above 30°C and below 20°C, ±(5 ppm of setting +1 ppm of range +1 µV)/°C to 200V, ±(5 ppm of setting +2 ppm of range)/°C, 200V to 1100V
Short Term Stability: (For 10 minutes from 0°C to 50°C) ±(10 ppm of setting +2 ppm of range +5 µV) to 500V; ±25 ppm of setting, 500V to 1100V
Load Regulation: External Sense, ±10 ppm from 2V to 1100V, no-load to full-load; Internal, Sense same as external except full-load is 400Ω

Alternating Voltage

Range*	Resolution	Maximum Load	Total Harmonic Distortion and Noise
20 mV	0.1 µV	Limited by 50Ω output resistance	Bandwidth of 10 Hz to 200 kHz, Distortion, line interference + noise including random spikes **20V and Higher** 50 Hz to 10 kHz: 0.08% of output rms **Below 20V** 50 Hz to 10 kHz: (0.05% of output + 10 µV) rms 10 kHz to 50 kHz: (0.08% of output + 20 µV) rms
200 mV	1 µV		
2V	10 µV	2 kΩ/ 1000 pF	
20V	100 µV	25 mA/ 1000 pF	
200V	1 mV	10 mA/ 400 pF	
1100V	10 mV	6 mA/ 400 pF**	

** Can be set in dBm where 0 dBm + 1 mW in 6008 + 0.7746V*
***200 mA/1500 pF with 5205A, Y5000 and Y5001*

Uncertainty: ±(0.035% of setting +0.005% of range +50 µV) from 50 Hz to 10 kHz and ±(0.06% of setting +0.008% of range +50 µV) from 10 kHz to 50 kHz for 6 months, 20°C to 30°C ambient
Frequencies Available (Hz): 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600, 700, 800, and 900 for all voltage ranges

Frequencies Available (kHz):

Voltage Range	1	2	3	4	5	6	7	8	9	10	20	30	40	50
110V to 1100V	•	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
20V to 110V	•	•	•	•	•	•	•	•	•	•	•	Δ	Δ	Δ
1 mV to 20V	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Δ With 5205A, Y5000, and Y5001

Frequency Uncertainty: ±3%
Temperature Coefficient: Above 30°C and below 20°C ±(20 ppm of setting +2 ppm of range)/°C for amplitude, ±0.1%/°C for frequency
Short Term Stability: ±(0.01% of range +10 µV) for 10 minutes from 0°C to 50°C
Load Regulation: External Sense, ±200 ppm from 0.2V to 1100V, no-load to full-load; Internal Sense, same as external except regulation for voltages <0.2V is expressed as an output impedance of 50Ω

Direct Current

Range	Resolution	Compliance Voltage	Ripple and Noise
200 µA	1 nA	0 to 10V	(0.05% of output +0.01 µA) rms Measured with 10 Hz to 10 kHz bandwidth including random spikes
2 mA	10 nA		
20 mA	100 nA		
200 mA	1 µA		
2A*	10 µA	0 to 2.1V	

**20A with 5220A, Y5000, and Y5002*

Uncertainty: ±0.015% of setting +0.002% of range +0.01 µA) for compliance voltage up to 1V. Add 0.002% of setting per volt above 1V rms, applies for 6 months and 20°C to 30°C ambient
Temperature Coefficient: Above 30°C and below 20°C ±(10 ppm of setting +2 ppm of range)/°C
Short Term Stability: ±(50 ppm of setting +5 ppm of range +0.002 µA) for 10 minutes from 0°C to 50°C
Load Regulation: ±20 ppm/volt for change in output voltage from 1 volt to maximum compliance voltage

Alternating Current

Range	Resolution	Compliance Voltage	Total Harmonic Distortion & Noise
200 µA	1 nA	0 to 7V	(0.05% of output +0.01 µA) rms Measured with 10 Hz to 10 kHz bandwidth including random spikes
2 mA	10 nA		
20 mA	100 nA		
200 mA	1 µA		
2A*	10 µA	0 to 1.4V	

**20A with 5220A, Y5000, and Y5002*

Uncertainty: ±0.05% of setting +0.005% of range +0.02 µA) for compliance voltage up to 1V rms (50 Hz to 1 kHz). Add 0.005% of setting per volt above 1V rms. Applies for 6 months in 20°C to 30°C ambient.
Temperature Coefficient: Above 30°C and below 20°C ±(25 ppm of setting +10 ppm of range +0.2 nA)/°C for amplitude, +0.1%/°C for frequency
Short Term Stability: ±(0.014% of setting +0.002% of range +0.4 µA) for 10 minutes from 0°C to 50°C

Load Regulation: ±(50 ppm +20 nA)/volt for change in output voltage from 1 volt to maximum compliance voltage

Resistance

Range: 1Ω to 10 MΩ in decade steps
Uncertainty: ±0.003%, except ±0.015% (1Ω), ±0.010% (10Ω and 1 MΩ), and ±0.030% (10 MΩ) assumes 4 terminal below 100 kΩ, applies for 6 months 20°C to 30°C ambient
Power Dissipation: 1W maximum except 100 mW max (1 MΩ) and 10 mW max (10 MΩ)
Temperature Coefficient: Above 30°C and below 20°C, ±5 ppm/°C except ±10 ppm/°C (1Ω and 10Ω), ±10 ppm/°C up to 40°C (10 MΩ), and ±50 ppm/°C above 40°C (10 MΩ)

Option Specifications

Wideband aV Option (-03)

Option -03 is an accurate, low-noise, flat alternating voltage source that allows the 5100B Series to be used for calibrating wideband voltmeters. Frequency coverage expands to 10 Hz-10 MHz. A dedicated front panel BNC connector provides ac output from 300 µV (-57.5 dBm) to 3.1623V (+23 dBm) into 50Ω impedance. The output is programmable from the front panel or I/O interface in volts or in dBm (where 0 dBm equals 1 mW into 50Ω). Using a simple formula for calculation of a correction factor and the new REF feature, the wideband output can be directly programmed for dBm referenced to other impedances.
Range: 10 Hz to 10 MHz

Amplitude Uncertainty, at 1 kHz, Terminated in 50Ω*

Voltage Range	Approx dBm Range	±(% of Setting + % of Range)
1V-3.1623V	+13 to +23	0.25 + 0.25
0.31624V-0.99999V	+3 to +13	0.5 + 0.25
0.1V-0.31623V	-7 to +3	0.75 + 0.25
31.624mV-99.999mV	-17 to -7	1.0 + 0.25
10mV-31.623mV	-27 to -17	1.25 + 0.25
3.1624mV-9.9999mV	-37 to -27	1.5 + 0.25
1mV-3.1623mV	-47 to -37	1.75 + 0.25
300µV-0.99999 mV	-57.5 to -47	2.0 + 0.25

**For 6 months, 20°C to 30°C ambient*

Amplitude Flatness*
10 Hz to 30 Hz: ±0.3%
30 Hz to 1 MHz: ±0.25%
1 MHz to 5 MHz: ±0.25% above 1 mV, ±0.6% ≤1 mV
5 MHz to 10 MHz: ±0.6%
**Using 1 foot of RG 58U cable terminated in 50Ω*
Temperature Coefficient: Above 30°C and below 20°C ±(0.1 times basic accuracy)/°C for amplitude; ±0.25%/°C for frequency
Harmonics: -40 dB or lower relative to fundamental for each frequency except -32 dB above 5 MHz

Spurious Outputs: -50 dB or lower relative to fundamental for each frequency
Frequency Resolution: 1 MSD
Frequency Uncertainty: ±3%

GPIB/IEEE-488* Interface Option (-05)

This interface allows the 5100B Series to be used in a system compatible with GPIB/IEEE Std 488-1978. System control is via the Fluke 1722A or 1752A Instrument Controller or any host computer. Address coding is done using logic switches accessible on the rear panel. Data is transmitted bi-directionally in ASCII coded format. The following subsets are supported: SH1, AH1, T6, L4, SR1, RL1, DC1, and E2.

Bit Serial Interface Option (-06)

Provides compatibility with EIA Standard RS-232C or 20 mA current loops. Thirteen baud rates are available from 50 to 9600 and either one or two stop-bits can be set up. Selection is made via rear panel logic switches.

General Specifications

Shock and Vibration: Meets requirements of MIL-T-28800 for Class 5, Style E equipment
Temperature
5100B and 5102B: 0°C to 50°C operating; -20°C to +65°C non-operating
5101B: (With mini-cassette tape) +10°C to +40°C operating; +4°C to +50°C, non-operating. Without mini-cassette: same as 5100B.
Relative Humidity: 85% to 35°C, ≤70% to 40°C, ≤50% to 50°C

Power: 100, 110, 115, 120, 200, 220, 230, 240V ac, switch-selectable ±10%, 50 Hz to 60 Hz; 200VA (5100B) or 220VA (5101B) with all options
Size: 22.2 cm H x 60.3 cm W x 43.2 cm L (8.75 in H x 17 in W x 23.75 in L)
Weight
5100B: 30.4 kg (67 lb) basic, 32.7 kg (72 lb) with all options
5101B: 32.7 kg (72 lb) basic, 34.9 kg (77 lb) with all options
5102B: 35.8 kg (79 lb) basic, 38.1 kg (84 lb) with all options

Ordering Information

Models

5100B Calibrator
5101B Calibrator, w/procedure storage
5102B Calibrator in portable case
5205A* Power Amplifier
5220A* Transconductance Amplifier
**Y5001 or Y5002 cable and Y5000 interface required when used with 5100B Series Calibrator*

Included with Instrument
One-year product warranty, line cord, Operator's manual, and Performance Verification Record. Also one mini-cassette tape with 5101B.

Options (for 5100B, 5101B, 5102B)
-03 Wideband AC Voltage
-05* IEEE-488 Compatible Interface
-06* EIA RS-232C Interface
**Cannot have -05 and -06 together*

Accessories (Also see Section 19)
5100A-7003K* Fiberglass Carrying Case, for 5100B/5101B
5100A-7005K Extender Kit
M08-205-600 $8^3/_4$" Rack Mount Kit, 5100B/5101B
M00-280-610** 24" Rack Slides
Y5000 Interface Buffer for 5205A and 5220A
Y5001 Interface Cable for 5205A and Y5000
Y5002 Interface Cable for 5220A and Y5000
Y8021 Shielded IEEE-488 Cable, 1m
Y8022 Shielded IEEE-488 Cable, 2m
Y8023 Shielded IEEE-488 Cable, 4m
Y8007 Mini-cassettes, 10-pack for 5101B
**Cannot be used as a shipping case*
***Requires M08-205-600*

Manuals
5100B Series Operator*
5100B Service
5205A Instruction*
5220A Instruction*
**No charge with purchase of unit*

National Stock Numbers
5100B 6625-01-099-2414
5101B 6625-01-105-3598
5102B with -03 and -05 6625-01-233-7104

Customer Support Services

Also see Section 20.

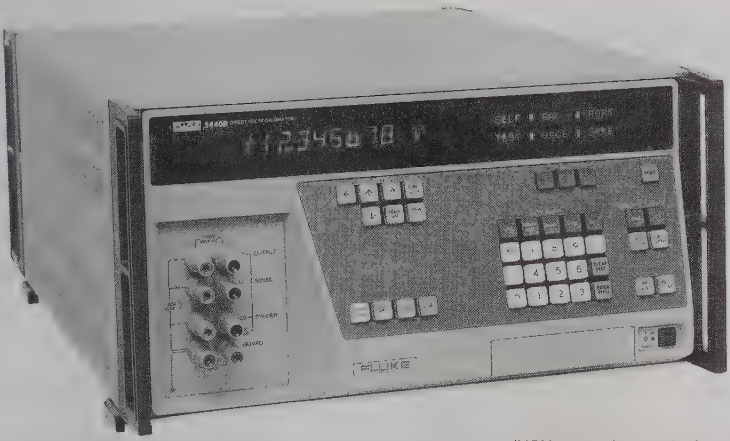
Factory Warranty
One-year product warranty.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

5440B

GPIB
IEEE-488

RS-232



(NSN 6625-01-226-5448) **5440B**

5440B Direct Voltage Calibrator

- Full accuracy over extended temperature range of 10°C
- Completely automatic internal calibration, no mechanical adjustments
- Simplified 5-minute external calibration to traceable standards
- Procedure Storage Module for single button test setup
- Completely programmable through the GPIB/IEEE-488 interface
- Serial printer output for calibration constants and instrument test results

The 5440B is equipped with bright vacuum-fluorescent displays for clear visibility at any viewing angle. Even inexperienced operators find the 5440B easy to use because the 40-character, alphanumeric display provided in addition to the numeric output display, makes operating instructions and error messages clear and readable in engineering units and English language messages instead of coded numerics. For semi-automated testing, the 5440B allows a complete test sequence of up to 60 steps to be stored in the internal Procedure Storage memory and recorded for later use in the interchangeable, plug-in Procedure Storage Modules. A test sequence is recalled and executed one step at a time with each touch of the NEXT STEP key.

The 5440B comes equipped with the Procedure Storage Module capability and boost capability for driving the 5205A Precision Power Amplifier and 5220A Transconductance Amplifier in system applications. The rear output terminals are found on the 5440B as a standard feature. The instrument has outstanding accuracy specifications and the capability for operating at full rated accuracy over a temperature range of ±5°C from the calibration temperature, making it well-suited for operation in a production environment as well as in a standards lab. The 5440B is completely programmable via the GPIB/IEEE-488* interface which is included at no extra cost.

The outstanding accuracy specifications for the 5440B are easily maintained in any lab by performing the simple, automatic calibration procedures which store the calibration constants in non-volatile solid-state memory. No hardware adjustments are required. The Fluke 732B DC Standard combined with the Fluke Direct Volt Maintenance Program and the Fluke 752A Reference Divider, provide the highest accuracy reference standards available for this periodic calibration.

Specifications

Output Voltage: 0 to 1100V
Output Current: 0 to 60 mA up to 22V, except divided outputs; 0 to 25 mA up to 1100V
Output Uncertainty Compared to Calibration Standards, ±5°C

Range	Uncertainty Specification: ±(PPM of Output + Microvolts)	
	30 Days	**90 Days**
0V to 11V	1.5 + 5 µV	2.0 + 5 µV
11V to 22V	1.5 + 8 µV	2.0 + 8 µV
22V to 275V	2.5 + 100 µV	3.5 + 100 µV
275V to 1100V	2.5 + 400 µV	3.5 + 400 µV
Divided Output		
0V to 220 mV	4 + 0.5 µV	5 + 0.5 µV
0.22V to 2.2V	3 + 1 µV	4.5 + 1.0 µV
Range	**180 Days**	**1 Year**
0V to 11V	2.5 + 5 µV	3.5 + 5 µV
11V to 22V	2.5 + 8 µV	3.5 + 8 µV
22V to 275V	4.5 + 100 µV	6.0 + 100 µV
275V to 1100V	4.5 + 400 µV	6.0 + 400 µV
Divided Output		
0V to 220 mV	6.5 + 0.5 µV	10 + 0.5 µV
0.22V to 2.2V	6 + 1.0 µV	8 + 1.0 µV

Uncertainty of Calibration Standards Compared to National Standards

Range	Uncertainty of Standards
0V to 11V	1.5 ppm
11V to 22V	1.5 ppm
22V to 275V	1.7 ppm
275V to 1100V	2.0 ppm
0V to 220 mV	4.0 ppm
0.22V to 2.2V	2.0 ppm

The output uncertainty compared to national standards for the 5440B is defined as the algebraic sum for each range of the output uncertainty compared to calibration standards and the uncertainty of the calibration standards compared to national standards. The specifications for uncertainty of calibration standards listed above are those for the Fluke 732B and Fluke 752A. If other standards are used, the uncertainty of those standards must be substituted.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Output Stability

Specifications apply for initial stabilization of two hours, constant ambient temperature of ±1°C, constant line voltage, constant load, and measurement bandwidth of 0.1 Hz to 1 Hz.

Range	±(PPM of Output + Microvolts)		
	10 Minutes	24 Hours	30 Days*
0V-11V	0.2 + 2 µV	0.3 + 3 µV	0.5 + 3 µV
11V-22V	0.2 + 3 µV	0.4 + 4 µV	0.5 + 4.5 µV
22V-275V	0.3 + 40 µV	0.3 + 50 µV	1.0 + 60 µV
275V-1100V	0.3 + 200 µV	0.3 + 200 µV	1.0 + 300 µV
Divided Output			
0 mV-220 mV	0.5 + 0.2 µV	0.5 + 0.2 µV	2 + 0.3 µV
0.22V-2.2V	0.5 + 0.2 µV	0.5 + 0.5 µV	2 + 0.7 µV

* *For best results, use internal calibration for periods exceeding one day*

Temperature Coefficient of Output

These specifications apply for ambient temperatures outside the ±5°C range of the uncertainty specifications listed earlier.

Range	±(PPM of Output) Per °C	
	0-10°C	10-30°C
0V to 11V	0.15 ppm	0.1 ppm
11V to 22V	0.15 ppm	0.1 ppm
22V to 275V	0.2 ppm	0.2 ppm
275V to 1100V	0.2 ppm	0.2 ppm
Divided Output		
0V to 220 mV	0.5 ppm	0.5 ppm
0.22V to 2.2V	0.5 ppm	0.5 ppm
Range	**30-40°C**	**40-50°C**
0V to 11V	0.4 ppm	1.0 ppm
11V to 22V	0.4 ppm	1.0 ppm
22V to 275V	0.6 ppm	1.5 ppm
275V to 1100V	1.0 ppm	1.5 ppm
Divided Output		
0V to 220 mV	0.5 ppm	0.5 ppm
0.22V to 2.2V	0.5 ppm	0.5 ppm

Linearity

These specifications apply for the ambient temperature range of 15°C to 30°C within ±5°C of the external calibration temperature.

Range	±(PPM of Output + Microvolts)
0 mV to 220 mV	0.5 ppm + 0.2 µV
0.22V to 2.2V	0.7 ppm + 0.3 µV
0V to 11V	0.5 ppm + 1.5 µV
11V to 22V	0.5 ppm
22V to 275V	0.5 ppm + 40 µV
275V to 1100V	1.0 ppm

Resolution

Range	Resolution	Maximum Load or Output Resistance
0V to 11V	1 µV	25 mA
11V to 22V	1 µV	
22V to 275V	10 µV	
275V to 1100V	100 µV	
Divided Output		
0V to 220 mV	0.01 µV	495Ω
0.22V to 2.2V	0.1 µV	450Ω

Output Noise

Range	Bandwidth	
	0.1 Hz to 10 Hz	10 Hz to 10 kHz
0 mV to 220 mV	0.1 µV	5 µV
0.22V to 2.2V	0.2 µV	15 µV
0V to 11V	1.5 µV	30 µV
11V to 22V	3.0 µV	50 µV
22V to 275V	35 µV	150 µV
275V to 1100V	100 µV	300 µV

Output Settling Time

Time to settle within a given uncertainty band of final value, for a change in programmed output within a given range.

Range	±PPM of Change*		
	3 seconds	5 seconds	10 seconds
0 mV to 220 mV, 0.22V to 2.2V, 0V to 11V, and 11V to 22V	7 ppm	2 ppm	0.5 ppm
22V to 275V 275V to 1100V	–	–	3 ppm

* *Add 0.5 seconds for any change in range up to 22V, 1.0 second for a change from 22V up, and 0.5 seconds for a change from STBY to OPER*

Line Regulation: Changes less than ±0.1 ppm of range for ±10% change from nominal line voltage

Load Regulation: Less than ±0.1 ppm change of output for change from no-load to full-load or from full-load to no-load for output load impedances greater than 80 ohms

Common Mode Rejection: Greater than 140 dB for frequencies from dc to 400 Hz

Temperature: 0°C to 50°C, operating, except accuracy is degraded above 40°C due to loss of oven regulation; -40°C to +75°C non-operating

Relative Humidity: ≤90% to 30°C except accuracy is degraded above 80%, ≤70% to 40°C, ≤40% to 50°C

Vibration

Frequency	Force	Double Amplitude
5 Hz to 15 Hz	0.7G at 15 Hz	0.06 inches
15 Hz to 25 Hz	1.3G at 25 Hz	0.04 inches
25 Hz to 55 Hz	3G at 55 Hz	0.02 inches

Shock: Eighteen 20G $^{1}/_{2}$-sinewave shocks

Compliance With External Standards: ANSI C39.5 Dec 1980, IEC 348 Second Edition 1978, UL 1244 and CSA Bulletin 556B

EMI/RFI Review Standards: FCC Rules Part 15, Subpart J; European Standard VDE 0871; MIL STD 461B

EMI/RFI Conducted Emissions: FCC Rules Part 15 Class J; European Standard VDE 0871; CISPR.11

Radiated EMI/RFI Emissions: Meets or exceeds all FCC and VDE requirements

Power: 100V, 110V, 115V, 120V ac ±10% or 200V, 220V, 230V, 240V ac ±10%, 50 to 60 Hz, 84W standby, 145W nominal

Size: 61 cm L x 43 cm W x 24 cm H (24 in L x 17 in W x 9.4 in H)

Weight: 30.2 kg (66.4 lb)

Mounting: Standard 19" EIA relay rack, tapped for attachment of slides; resilient feet provided for bench use

Ordering Information

Model

5440B Direct Voltage Calibrator
NSN 6625-01-226-5448

Included with Instrument

One-year product warranty, line cord, procedure storage module, IEEE-488, RS-232C boost interface, rear output, and Operator's, Service & Getting Started manuals.

Accessories (Also see Section 19)

5440A-7001 Procedure Storage Module
5440A-7002 Low Thermal Copper EMF Plug-In Cables
732B DC Standard
732B-000 Special Calibration, shipped hot
732B-100 Special Calibration and Drift Certification, shipped hot
752A Reference Divider
M08-205-600 $8^{3}/_{4}$" Rack Mount Kit
M00-280-610 24" Rack Slide Kit (Requires M08-205-600)

Manuals

5440B Service*
544X Series Operator*
544X Getting Started*
544X Remote Programming*

**No charge with purchase of unit*

Customer Support Services

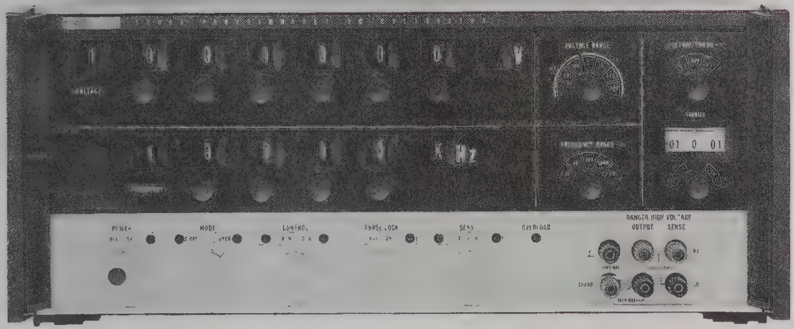
Also see Section 20.

Factory Warranty

One-year product warranty.

5200A

GPIB
IEEE-488



(NSN 6625-01-063-6325) **5200A**

5200A Precision Alternating Voltage Calibrator

- Seven voltage ranges from 1 mV to 1000V
- 6½ digit resolution
- Output frequencies from 10 Hz to 1 MHz
- GPIB/IEEE-488 system interface available
- Phase-lock input
- Completely guarded
- Short and overload protected

A Proven Performer

The Model 5200A Alternating Voltage Calibrator is a precision high-performance alternating voltage source with proven reliability and exceptional stability and accuracy over a broad frequency range. It is specified over a wide 0°C to 50°C operating range for use in both laboratory and manufacturing environments. Amplitude is controlled in six ranges from 1 mV to 100V. Resolution to 1,199,999 counts yields 20% overrange capability with 1 nV steps on the 1 mV range, up to 0.1 mV steps on the 100V range. Outputs from 100 µV rms to 120V rms are provided, with up to 50 mA load current capability.

An additional 1000V range is included for front panel or remote interface control of a 5205A Precision Power Amplifier.

Amplitude error measurement for voltmeter calibration is provided in two ranges, ±3% and ±0.3%. Error measurements can be resolved to 10 ppm.

Five frequency ranges are provided from 100 Hz to 1 MHz, with 119,999 count resolution for 20% overrange capability with 0.01 Hz steps on the 100 Hz range, up to 100 Hz steps on the 1 MHz range.

The oscillator of the 5200A may be phase locked to an external source to produce synchronous signals of precision amplitude and stability. Signal phase is locked within ±1° of phase angle, ±0.05°/kHz, over a ±2% band around the center frequency. This capability is essential for 60 Hz calibration.

A 3V pulse signal is provided for monitoring frequency with an external counter.

A quadrature output signal is provided which leads the fundamental signal phase by 90°. Amplitude varies from 1V to 10V rms, proportional to the fundamental signal output level on any range. This signal is useful for wattmeter calibration, and for research and development tasks that use the 5200A as a precision source.

External sensing may be selected, bringing rated accuracy to the load point bypassing losses in output leads.

Outputs are protected from overload by current limiting. Overload response time is typically 2 microseconds. When an overload is removed output recovers automatically to its previous level.

The 5200A is a fully-guarded calibrator. This allows floating operation, and eliminates system ground loop problems. This is especially useful for calibrating non-guarded equipment.

Remote Programming (Opt -01 or -05)

The 5200A is remotely programmable in all functions except Power, Remote/Local, and Vernier Voltage Error. For any programmed amplitude, the output settles to its specified uncertainty within 0.5 seconds for frequencies above 100 Hz, and within 4 seconds for frequencies below 100 Hz. Program status flags are provided to indicate settling time and current limit conditions to the controller.

Either the 5200A-01 Parallel Remote Control Interface or the 5200A-05 GPIB/IEEE-488* System Interface may be installed in the 5200A, for complete remote control of both the 5200A Calibrator and a 5205A Power Amplifier.

The 5200A-01 Parallel Remote Control Interface provides excellent isolation between external system logic and internal calibrator circuitry. This isolation is typically $10^9\Omega$ in parallel with 30 pf capacitance. This effectively attenuates external logic and ground noise better than 100:1 at 10 MHz.

Command data is segmented into 4-bit groups that can be programmed separately or simultaneously. Command data is stored both inside and outside the guard.

5200A-01 programming levels are compatible with TTL logic, and with contact closure:

Standard levels:
Logic 1 or true = 0V to +0.4 dV
Logic 0 or false = +2.8V to +5.0 dV
(For inverted logic levels, also order option 5200A-03.)

The 5200A-01 includes both standard and blank address matrix cards, and a mating connector.

The 5200A-05 IEEE-488 System Interface incorporates subsets SH1, AH1, T6, TEO, L4, LEO, SR1, RLO, PPO, DC2, and DTO of IEEE Standard 488-1980. The 5200A-05 may be addressed for a 2-byte status response or serial polled for a 1-byte response. Status information includes Remote/Local, Standby/Operate, limits, settling time, and out-of-range instruction.

Specifications

Technical Specifications

Amplitude Uncertainty

Specified for 180 days. Specifications are valid when operating in an ambient temperature between 18°C and 28°C after a 1-hour warm-up.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

5200A

Basic Instrument Absolute Uncertainty [1]		
Voltage Ranges	**Frequency Hz**	**±(ppm setting + µV)**
1 mV [2] 10 mV	10 - 30	1000 + 10
	30 - 20k	200 + 10
	20k - 100k	500 + 20
	100k - 1M	3300 + 30
100 mV	10 - 30	1000 + 10
	30 - 20k	200 + 10
	20k - 100k	500 + 20
	100k - 1M	3300 + 30
		±(ppm setting + ppm range)
1V 10V 100V	10 - 30	1000 + 50
	30 - 20k	200 + 20
	20k - 100k	500 + 50
	100k - 1M	3300 + 30
1000V [3]	10 - 30	1200 + 50
	30 - 20k	400 + 40
	20k - 50k	800 + 50
	50k - 100k	1000 + 100

[1] Valid for 180 days, between 18°C and 28°C, after 1-hour warm-up
[2] On 1 mV range, specification applies for measuring instruments with less than 2 MHz bandwidth
[3] Output is through a 5205A Power Amplifier

Voltage Resolution

Range	Voltage Settings	Resolution
1 mV	0.100000 mV to 1.199999 mV	1 nV
10 mV	1.00000 mV to 11.99999 mV	10 nV
100 mV	10.0000 mV to 119.9999 mV	100 nV
1V	0.100000V to 1.199999V	1 µV
10V	1.00000V to 11.99999V	10 µV
100V	10.0000V to 119.9999V	100 µV
1000*	100.000V to 1199.999V	1 mV

** Output is through a 5205A Power Amplifier*

Stability

Voltage Ranges	Frequency Hz	Stability [1] (ppm setting + ppm range) [2]	
		10 Minutes	**180 Days**
1 mV 10 mV	10 - 30	70 + 40	300 + 60
	30 - 20k	70 + 3 [3]	100 + 30
	20k - 100k	70 + 3	130 + 40
100 mV	10 - 30	70 + 40	300 + 60
	30 - 1k	70 + 3 [3]	70 + 40
	1k - 20k	70 + 3	100 + 30
	20k - 50k	70 + 3	120 + 50
	50k - 100k	70 + 3	100 + 130
1V 10V 100V	10 - 30	70 + 40	200 + 20
	30 - 20k	35 + 5 [3]	45 + 5
	20k - 50k	55 + 5	65 + 5
	50k - 100k	70 + 3	220 + 20
1000V [4]	10 - 100	0 + 50	200 + 0
	100 - 20k	70 + 5	200 + 0
	20k - 100k	70 + 5	400 + 0

[1] Constant line, load, and temperature
[2] Total peak to peak random change in rms value
[3] For frequencies below 50 Hz, floor is 40 ppm of range
[4] Output is through a 5205A Power Amplifier

Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add ±(0.025 x uncertainty) per °C below 18°C or above 28°C; for the 1000V range add ±(0.03 x uncertainty) per °C
Maximum Load: 1 mV, 10 mV, 100 mV ranges: minimum 6000Ω load impedance; 1V*, 10V, 100V ranges: maximum load current 50 mA; 1000V range: maximum load current 200 mA
**Minimum load impedance 50Ω above 0.1 MHz*

Voltage Error Control: Switch selectable OFF, on two ranges: 0 to ±0.3% with 10 ppm resolution; 0 to ±3% with 100 ppm resolution

Settling Time

Frequency Hz	Settling Time,* Seconds
10 - 30	4 to 15
30 - 100	4
100 - 400	2
400 - 1M	1**

** To within 100 ppm of change*
*** Typically less than 0.5 second, except frequency range changes*

External Sense: Switch selectable, internal or external, available on 1V, 10V, and 100V ranges*. Output rises to less than 2.0V rms above selected level when sense lines are disconnected in external sense mode.
** Output impedance on 1 mV, 10 mV, and 100 mV ranges is less than 1.5Ω in series with 15 µH*

Frequency Performance*

Range	Frequency Settings	Resolution Hz**	Uncertainty ±(% of input + % of Range)
100 Hz	10.00 Hz to 119.99 Hz	0.01	1.0 + 0.1
1 kHz	.1000 kHz to 1.1999 kHz	0.1	
10 kHz	1.000 kHz to 11.999 kHz	1	
100 kHz	10.00 kHz to 119.99 kHz	10	
1 MHz	.1000 MHz to 1.999 MHz	100	3.0 + 0.3

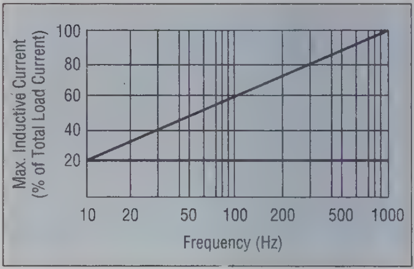
** 180 days, 18°C to 28°C, after 1-hour warm-up*
***100 ppm of range*

Total Harmonic Distortion and Line-Related Noise*

Frequency Hz	±(% of setting + µV rms)
10k - 100k**	0.04% + 10
100k - 500k	0.3% + 30
500k - 1M	1.0% + 30

** Bandwidth 10 Hz to 10 MHz, and less than 15 mA output current except 1000V range. See 5205A specifications.*
*** 1V range is ±0.08% from 10 Hz to 15 Hz*

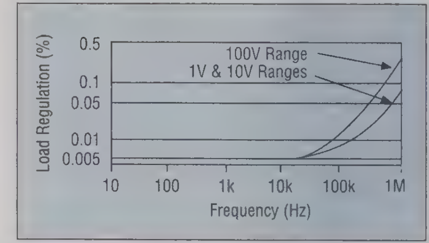
Maximum Capacitive Load: 1000 pF on 1 mV-100V ranges, 1500 pF on 1000V range
Maximum Inductive Load Current: (Except 1000V range)



Phase Lock Input: 1V to 10V rms, useable down to 100 mV rms
Phase Lock Accuracy: ±3° below 30 Hz, and ±(1° + 0.05° per kHz) over a ±2% band around center frequency

Quadrature Output

Amplitude: 1V to 10V rms, ±10%, proportional to selected output voltage
Phase: 10 Hz to 40 Hz, 90° ±3°; 40 Hz to 1.2 MHz, 90° ±(1° + 0.03° per kHz)
Minimum Load: 3 kΩ impedance
Current Limit: Typical transition time, 2 µs; recovery within specified settling time
Volt-Hertz Product: Output voltage x frequency $\leq 10^7$. Full 120V rms output is maintained up to 83.33 kHz. Maximum output voltage at 1.2 MHz is 8.33V rms.
Load Regulation: 50 ppm of range, no load to full load, up to 10 kHz



General Specifications

Maximum Isolation Voltages: (dc or peak ac) 500V, GUARD to chassis; 100V, LO to GUARD
Temperature: 0°C to +50°C operating, -40°C to +75°C storage
Input Power: Switch selectable, 100V, 115V, 200V, 230V ac, 100W
Size: 17.8 cm H x 43.2 cm W x 53.3 cm D (7 in H x 17 in W x 22.5 in D)
Weight: 24.1 kg (53 lb)

Ordering Information

Models

5200A AC Calibrator
5205A Precision Power Amplifier w/remote control

Included with Instrument

One-year product warranty, line cord, Instruction manual, connector set, and Certificate of Calibration Practices.

Options (for 5200A)
-01* Parallel Remote Control Interface
-03 Logic Inversion (for 5200A-01)
-05** IEEE-488 Compatible Interface

**Cannot be used with 5200A-05*
***Cannot be used with 5200A-01*

Accessories (Also see Section 19)
M07-205-600 7" Rack Mount Kit for 5200A
M10-205-600 10$^1/_2$" Rack Mount Kit for 5205A
M00-280-610 24" Rack Slides for rack mount kit
Y1790 5$^1/_4$" Rack Mount Kit w/24" Slides for 1722A
5200A-7015K Extender Board Kit

Manuals
5200A Instruction*
5200A Getting Started

**No charge with purchase of unit*

Customer Support Services

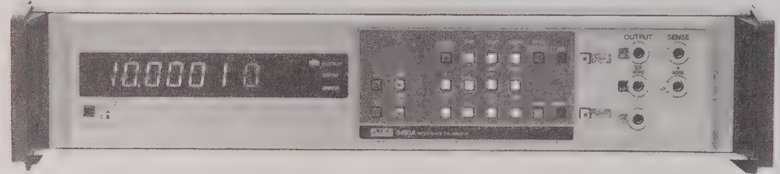
Also see Section 20.

Factory Warranty

One-year product warranty.

5450A

GPIB
IEEE-488



(NSN 6625-01-249-6325) **5450A**

5450A Resistance Calibrator

- 17 standard resistors in one enclosure
- Decade values from 1.0Ω to 100 MΩ
- 1.9 multiples from 1.9Ω to 19 MΩ
- True passive resistors for low noise and offset
- Midband accuracy of 8 ppm over 18°C to 28°C
- 4-wire or 2-wire operation
- Easy data entry for test lead compensation
- Automatic meter error calculation
- GPIB IEEE-488 programmable

The 5450A Resistance Calibrator is designed to verify the resistance-measuring accuracy of precision multimeters, either manually or as part of an automated calibration process. It complements the 5440A Direct Voltage Calibrators.

The 5450A provides cardinal point resistance values in decade steps from 1Ω through 100 MΩ and decade steps from 1.9Ω through 19 MΩ.

The known value of each resistance is stored internally and used for calibration purposes. Each value is displayed to 1 ppm resolution.

Four-wire connections eliminate the effects of lead resistance or, for 2-wire operation, you may measure and store the lead resistance value and automatically subtract it from the value of each resistor. Connections to the instrument being calibrated may be made to the front panel terminals or to special rear panel binding posts that contribute very low thermal offset voltage errors.

Calibrating the 5450A consists of storing the right values of each resistor. Recalibration can be accomplished without removing the instrument covers, and may even be done remotely over the GPIB IEEE-488* bus. A rear panel switch insures integrity of calibration.

The 5450A displays the precise value of each selected resistor and can show the error of the instrument being calibrated either in percent or in parts per million. All functions that can be controlled from the front panel may be controlled remotely via an IEEE-488 bus. No options are required to make the 5450A compatible with the bus; interface circuits are built in.

Specifications

The analog specifications apply when the 5450A is calibrated using a 10 kΩ standard resistor, the absolute value of which is known within ±2 ppm or better and using the ratio calibration method for calibrating resistor values from 10Ω through 100 MΩ. The 1.0Ω and 1.9Ω value must be calibrated by comparison to a 1Ω standard whose absolute value is known within ±5 ppm.

Analog Specifications

Uncertainty, For Rated Current, 4-Wire Connections

Nominal Resistance	Absolute Uncertainty (±ppm unless indicated)				Normal Current Ranges	
	23°C ±1°C, ≤70% RH		23°C ±5°C, ≤70% RH			
	24 Hours	90 Days	90 Days	1 Year	Lower	Upper
Short	.1 mΩ	.1 mΩ	.1 mΩ	.1 mΩ	10 mA	500 mA
1Ω	50	62	75	110	10 mA	100 mA
1.9Ω	40	52	65	100	10 mA	75 mA
10Ω	18	20.5	25	33	10 mA	25 mA
19Ω	16	18.5	23	31	10 mA	25 mA
100Ω	7.5	9	11	16	10 mA	15 mA
190Ω	7	8.5	10.5	15.5	10 mA	15 mA
1 kΩ	5.5	7	8.5	13.5	700 μA	2.5 mA
1.9 kΩ	5	6.5	8	13	500 μA	2.5 mA
10 kΩ	5	6.5	8	13	50 μA	1 mA
19 kΩ	4.5	6	7.5	12.5	50 μA	1 mA
100 kΩ	6	7.5	9	14	5 μA	250 μA
190 kΩ	5.5	7	8.5	13.5	5 μA	250 μA
1 MΩ	7.5	10	11.5	19	5 μA	50 μA
1.9 MΩ	7.7	10	11.5	19	5 μA	25 μA
10 MΩ	16	24	26	50	.5 μA	5 μA
19 MΩ	20	28	30	56	.25 μA	2.5 μA
100 MΩ	65	90	120	200	.05 μA	.5 μA

Relative to National Standards such as U.S. National Institute of Standards and Technology

Temperature: 0°C to 50°C, operating
Relative Humidity: ≤70% for rated accuracy
Power: 100, 120, 220, or 240 aV ±10%, 50 Hz to 60 Hz ±5%, ≤50W
Size: 8.9 cm H x 43.2 cm W x 55.4 cm L (3.5 in H x 17 in W x 21.8 in L)
Weight: 9.3 kg (20.4 lb)

Ordering Information

Model

5450A Resistance Calibrator

Included with Instrument
One-year product warranty, line cord, Instruction manual, and Certificate of Calibration Practices.

Accessories (Also see Section 19)
Y8021 Shielded IEEE-488 Cable, 1m
Y8022 Shielded IEEE-488 Cable, 2m
Y8023 Shielded IEEE-488 Cable, 4m
M00-260-610* 18" Rack Slide Kit
M00-270-610* 20" Rack Slide Kit
M00-280-610* 24" Rack Slide Kit
Y8598 3½" Rack Mount Kit w/22" Slides
Y8599 3½" Rack Mount Kit
**Requires Y8599*

Manuals
5450A Getting Started
5450A Instruction*
**No charge with purchase of unit*

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

5205A

GPIB
IEEE-488

OPERATE
DANGER
HIGH VOLTAGE
LETHAL VOLTAGES MAY EXIST AT THIS OUTPUT WHENEVER INSTRUMENT IS TURNED ON. MAINTAIN CONNECTOR IN PANEL RECEPTACLE WHEN NOT IN USE.

(NSN 6625-01-068-6762) **5205A**

5205A Precision Power Amplifier

- Extends range of 5700A, 5100B Series, 5200A, or 5440B Calibrators
- Output voltages to 1100V rms, ±1500V dc
- Maximum output power 220 watts
- DC to 100 kHz, typical upper limit 120 kHz
- 420 ppm midband amplitude uncertainty at 1000V rms
- 200 ppm midband six-month stability
- Fully programmable

The 5205A Precision Power Amplifier is a dc coupled programmable inverting amplifer with a fixed gain of 100. Designed as a precision calibration amplifer, the 5205A is also useful as a general-purpose amplifier for a wide range of waveforms from dc to 100 kHz. Alternating voltage output level is specified to 1100V at up to 200 mA, with a typical upper limit of 1200V before automatically tripping into standby mode. Direct voltage output level is specified to ±1500V at up to 100 mA, with a typical upper trip limit of 1600V.

The 5205A includes automatic-overload sensing and recovery. Upon sensing an excessive slew rate or frequency of the input signal, or a momentary output overload, output is returned to zero within 2 microseconds and held there for 6 milliseconds or until the fault is corrected. When a steady overload, shorted output, or excessive input drive level is detected, the 5205A trips and locks into standby mode and displays a fault indicator.

A calibrator interface is standard, including an independent input signal line. When used with a 5700A, 5100B Series, 5200A, or 5440B Calibrator, the 5205A is controlled by the calibrator as an extension of its capabilities.

A remote control interface is also standard, and independent of the calibrator interface. This allows remote switching between the calibrator and an alternate signal input source through a front panel BNC connector.

Amplifier features of the 5205A include a gain uncertainty of as little as 0.04%, and a slew rate as high as 800 volts per microsecond.

The 5205A includes a 1-meter output cable with a protective shrouded connector. When used with a 5200A AC Calibrator, remote sensing is brought to this connection point for maximum accuracy. An insulated receptacle is provided on the front panel for safe storage of the output connector when not in use. Option 5205 -07, for system applications, moves this cable and the BNC amplifier input connector to the rear panel.

All calibration adjustments and lamp replacements can be performed without exposure to high voltage. The output amplifier and all of the printed circuit modules are easily removed for repair or exchange.

Specifications

Technical Specifications

Calibrator Mode

Amplitude Uncertainty with 5100B Series Calibrator

Absolute Uncertainty*	
Frequency Hz	±(ppm setting + mV)
dc	700 + 30
50-10k	800 + 100
10k-50k	1200 + 150

** Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 20°C to 30°C, after 1-hour warm-up.*

Amplitude Uncertainty with 5200A Calibrator

Basic Instrument Absolute Uncertainty*		Characterized Uncertainty**		
Freq Hz	±(ppm setting + ppm range)	Freq Hz	±(ppm setting + ppm range)	
			Relative	Absolute
10-30	1200 + 50	50-100	190 + 20	210 + 20
30-20k	400 + 20	100-10k	180 + 20	200 + 20
20k-50k	800 + 50	10k-20k	200 + 20	220 + 20
50k-100k	1000 + 100	20k-50k	310 + 30	630 + 30

** Includes transfer standards, dc reference source, and allowances for techniques. 90 days, 18°C to 28°C, after 1-hour warm-up.*

*** 180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900.*

Amplitude Uncertainty with 5700A or 5440B Calibrator: Use amplifier-mode gain uncertainty specifications

Output Voltage Range: 100V to 1099.999V, ±dV or rms aV

Output Voltage Resolution: 1 mV with 5200A or 5440B, 10 mV with 5100B Series

Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add ±(0.025 x uncertainty) per °C below 18°C or above 28°C

Stability with 5100B Series, or 5440B Calibrator: Use amplifier-mode gain stability specifications

Stability with 5200A Calibrator*

Frequency Hz	10 Minutes	24 Hours	6 Months
	±(ppm setting + ppm range)		
10-100	0 + 50	100 + 0	200 + 0
100-20k	70 + 5	100 + 0	200 + 0
20k-100k	70 + 5	200 + 0	400 + 0

**Constant line, load, and temperature, total peak to peak random change in rms value*

5205A

Amplifier Mode

Maximum Output Voltage: 1100V rms aV, ±1500V dV
Typical Overload Trip Voltage: 1200V rms aV, ±1600V dV
Maximum Input Voltage: 50V, dV or rms aV (without damage)
Frequency Range: 0 to 100 kHz
Typical Upper Trip Frequency: 120 kHz
Gain: X100, inverting

Gain Uncertainty

Maximum Load	DC to 20 kHz	20 kHz to 100 kHz
500Ω, 100 pF	±0.05%	±0.2%
5000Ω, 100 pF	±0.05%*	±0.15%
1 MΩ, 200 pF	±0.05%	±0.2%
1 MΩ, 500 pF	±0.06%	±0.4%
1 MΩ, 1000 pF	±0.08%	±0.8%
1 MΩ, 1500 pF	±0.1%	±1.2%

**±0.04%, dc to 10 kHz*

Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add per °C below 18°C or above 28°C: dc to 20 kHz: ±(0.03 x uncertainty); 20 kHz to 100 kHz: ±(0.06 x uncertainty)

Gain Stability

Frequency Range	Max Capacitive Load	24 Hours	6 Months
dc to 20 kHz	1500 pF	0.02%	0.06%
20 to 100 kHz	100 pF	0.08%	0.2%
20 to 100 kHz	1500 pF	0.4%	0.8%

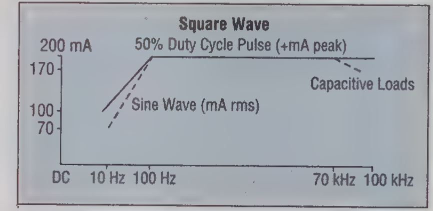
Maximum Slew Rates*

Maximum Load	Max Input Slew Rates	Max Output Slew Rates
200 mA Resistive	8.0V/µs	800V/µs
100 pF Capacitive	8.0V/µs	800V/µs
200 pF Capacitive	5.0V/µs	500V/µs
500 pF Capacitive	3.0V/µs	300V/µs
1000 pF Capacitive	2.0V/µs	200V/µs
1500 pF Capacitive	1.0V/µs	100V/µs

** Greater than 1000V output swing. Higher rates may trigger protection circuitry.*

Maximum Output Overshoot: Less than 4% of amplitude, with less than maximum input slew rate, and with greater than 1000V output swing

Maximum Isolation Voltage: Output common may be floated up to ±10V dc or rms ac from chassis to reduce common mode errors
Input Impedance: 10 kΩ in parallel with less than 120 pF
Input Connector: BNC, located on front panel. (located on rear panel with Option -07)
Maximum Input Voltage: 50V, dV or rms aV
Maximum Input Bias Current: 100 nA
Maximum Load Current: Bipolar symmetrical waveforms



Unipolar Rectangular Waveform:* ±200 mA peak with pulse width less than 5 msec; period greater than 10 msec.
Linearly Derating To: ±100 mA peak with pulse width greater than 50 msec; period less than 100 msec

** Referenced to zero volts. Under all circumstances, output current capability is at least ±100 mA peak*

Maximum Capacitive Load: 1500 pF, not to exceed rated load current. (Example: maximum capacitive load at 1000V, 100 kHz is 270 pF
DC Offset Voltage: ±10 mV at the output*
**90 days, 18°C to 28°C, after 1-hour warm-up*
Total Harmonic Distortion:* Resistive loads greater than 1500Ω or capacitive loads less than 1000 pF

10 Hz to 20 kHz	0.05% of setting
20 kHz to 50 kHz	0.07% of setting
50 kHz to 100 kHz	0.1% of setting

Resistive loads less than 1500Ω or capacitive loads greater than 1000 pF

10 Hz to 10 kHz	0.05% of setting
10 kHz to 20 kHz	0.1% of setting
20 kHz to 50 kHz	0.17% of setting
50 kHz to 100 kHz	0.25% of setting

**Bandwidth 10 Hz to 1 MHz*

Overload Protection: Limit protection against input noise spikes, momentary output over loads, excessive input slew rate, and excessive input frequency. Trip protection against input overdrive, steady overloads, and short circuit.
Random Noise: Less than 100 mV rms, 1 MHz bandwidth
Line-Related Noise: Less than 50 mV rms
Line Regulation: ±10 ppm of setting for 10% change in line voltage

General Specifications

Input Power: 100V, 115V, 200V, 230V ac, ±10%, internal jumper selected, 50 Hz to 60 Hz, 1800 VA at full load. Receptacle on rear panel for calibrator power.
Size: 26.7 cm H x 43.2 cm W x 62.7 cm L (10.5 in H x 17 in W x 24.7 in L)
Weight: 54.5 kg (120 lb)

Ordering Information

Models

5205A Precision Power Amplifier
5205A-07 With Rear Input/Output

Included with Instrument
One-year product warranty, accessory kit (5205A-7001), Instruction manual, and Certificate of Calibration Practices.

Accessories (Also see Section 19)
Y5000 Interface Buffer for 5100 Series
Y5001 Interface Cable for 5100 Series
Y5701 Cable, 5700A to 5205A
M10-205-600 10½" Rack Mount Kit
M00-280-610 24" Rack Slides for Rack Adapter

Manuals
5205A Instruction*
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

5220A

GPIB IEEE-488

RS-232

5220A TRANSCONDUCTANCE AMPLIFIER
VOLTAGE INPUT
CURRENT OUTPUT

(NSN 6625-01-083-3801) **5220A**

5220A Transconductance Amplifier

- 20 amps output dc or rms ac
- 0.025% basic dc accuracy
- Over-voltage and over-current protection
- Over-temperature protection
- May be programmed through a 5700A or 5100B

The 5220A Transconductance Amplifier lets you calibrate alternating or direct current meters and shunts and the current functions of digital multimeters that measure up to 20A. A known input voltage of 1 to 20 volts produces a known output current of 1 to 20A.

The 5220A is designed to be controlled by a 5700A or 5100B Series calibrator but may be driven by another voltage source such as the 5200A. When used with a 5100B Series, the current range of those instruments is extended by a factor of 10 to 1. Options are available for the 5100B Series that make the system GPIB/IEEE-488* and RS-232C compatible.

Built-in Protection

Protection is designed in to eliminate problems caused by excessive inputs, open inputs, and overcompliance. Indicators on the front panel tell the user about any of these conditions. Automatic shut down occurs should the internal temperature rise excessively.

Remote Operation

Drive voltage to the 5220A may be introduced through the front panel or the rear panel. The connector on the rear, however, allows the 5220A to become an extension to the current range of a 5700A or 5100B Series Calibrator.

The two instruments operate as one integrated calibration system with all the advantages of single control-point calibration; automatic error calculation, entry limit protection, etc.

A 5100B Series Calibrator requires a Y5000 Interface/Buffer to control a 5220A. A single Y5000 Interface Buffer may also be used to control a 5205A Power Amplifier.

Specifications

The specifications below apply for 180 days for instruments operated between 20°C and 30°C in a relative humidity of 70% or less.

Transconductance: 1 siemens (1A per volt)
Output Range: 0 to 20A dc or rms ac (28.3A peak)
Maximum Compliance Voltage: ≥±4V dc, or 3V rms ac (4.25V peak)
DC Accuracy: ±(0.025% of output +1 mA)
AC Accuracy: ±(0.05% of output +1 mA) from 30 Hz to 1 kHz, and ±(0.05% of output +1 mA) x f from 1 kHz to 5 kHz, where f = frequency in kHz
Short Term DC Stability: Output changes less than ±(0.005% + 200 µA) in 10 minutes, with constant line, load, and temperature
Short Term AC Stability: Output changes less than ±(0.01% + 500 µA) in 10 minutes, with constant line, load, and temperature
Harmonic Distortion and Noise: ±(0.05% of output ±1 mA) over frequency range of 30 Hz to 1 kHz and measured with a noise bandwidth of 300 kHz, ±0.05% of output +1 mA) x f from 1 kHz to 5 kHz, where f = frequency in kHz
Temperature Coefficient: ±(0.0025% of output +100 µA) per degree C, above 30°C or below 20°C
Transient Recovery: Output will settle to within 0.01% of final value within 2 seconds following a programmed change in output current or frequency (10 ms for 5220A alone)
Load Capability: Drives all resistive and capacitive loads consistent with current and compliance voltage capability. Drives inductive loads (with reduced accuracy) up to 200 microhenries, consistent with current and compliance voltage capability
Maximum Isolation Voltage: ±20V dc or 20V ac rms
Temperature Range: 0°C to 50°C (operating) and -20°C to 65°C non-operating
Relative Humidity: ≤50% to 50°C, ≤75% to 40°C, ≤95% to 25°C
Altitude: 0 to 10,000 feet (operating) and 0 to 40,000 feet (non-operating)
Vibration: 2G maximum, 5 Hz to 55 Hz for 15 minutes
Shock: 15G maximum, half sine waves
Power: 100, 110, 115, 120, 200, 220, 230, or 240V ac +10%, switch-selectable, 50 Hz to 60 Hz, 300W
Size: 17.8 cm H x 43.2 cm W x 55.9 cm D (7 in H x 17 in W x 22 in D), case only
Weight: 227 kg (50 lb)

Ordering Information

Model

5220A Transconductance Amplifier

Included with Instrument
One-year product warranty, line cord, Instruction manual, Certificate of Calibration Practices.

Accessories (Also see Section 19)
Y5020 Current Shunt
Y5000* Interface Buffer
Y5002* Cable (Y5000 to 5220A)
Y5702 Cable (5700A to 5220A)
M07-205-600 7" Rack Mount Kit
M00-270-610 20" Slides for Rack Mount Kit
M00-280-610 24" Slides for Rack Mount Kit
**Required when controlled from 5100B or 5101B*

Manuals
5220A Instruction**
***No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

---

* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

343A

(NSN 6625-00-238-1283) **343A**

343A DC Voltage Calibrator

- 0 to 1100V output, 0 to 25 mA
- 0.1 ppm resolution, seven decades
- 20 ppm basic accuracy
- Stability better than 5 ppm/hour, 15 ppm/month

The 343A is a 7-digit instrument with a basic accuracy of 20 ppm and a resolution of 1 µV on the 10 µV range.

Cleanliness of the dc output is evident in the combined ripple and noise specifications of 50 µV rms from the 343A. Short-term jitter and other random excursions are almost non-existent, less than 1 ppm.

A simple amplifier/comparator circuit is utilized to establish a convenient, variable, current limiter. Any maximum current output from 1 to 30 mA may be set via a front panel control. In addition to providing for current protection to the load, a failsafe "crowbar" protects the series-pass elements from damage should the total voltage across the elements exceed a safe level.

Specifications

Output Voltage: 0 to 1100 dV
Resolution: 1 µV on 10V range, 10 µV on 100V range, 100 µV on 1000V range

Uncertainty, 90 Days
10V Range: ±0.002% of setting or ±0.0002% of range*
100V Range: ±0.002% of setting or ±0.0001% of range*
1000V Range: Same as 100V range

**Whichever is greater*

NOTE: The above accuracies are absolute, relative to NIST standards, and include effects of stability, line regulation, load regulation, and calibration uncertainties under standard reference conditions of 23°C ±1°C and up to 70% relative humidity after 30-minute warm-up. Apply for 90 days.

Stability: ±% of Setting or ±Microvolts*

Time	10V Range	100V Range	1000V Range
Per Hour	0.005% or 5 µV	0.0005% or 10 µV	0.0005% or 20 µV
Per Month	0.0015% or 15 µV	0.0015% or 25 µV	0.0015% or 50 µV
Per 6 Months	0.0025% or 30 µV	0.0025% or 40 µV	0.0025% or 60 µV

**Whichever is greater*

Temperature Coefficient: ±(3 ppm of setting +0.1 ppm of range +2 µV) per degree Celsius from 24°C to 15°C or 25°C to 35°C
Regulation: <0.0005% of setting +25 µV for a 10% line voltage change or a full-load to no-load change
Isolation: May be floated 500 dV from chassis
Settling Time: Within 15 ppm of final output in 5 seconds
Overcurrent Protection: Automatically limits output current at any preset level between 1 mA and 30 mA via continuously variable front panel control. Panel lamp illuminates during limiting.
Meter: Switch-selectable to full range voltage or full range current
Remote Sense: Separate terminals are provided for sensing the output voltage directly at the load
Temperature: 0°C to 50°C, operating
Power: 115 or 230V ac ±10%, 50 to 440 Hz, approximately 60 VA fully loaded
Size: 8.9 cm H x 43.2 cm W x 45.7 cm D (3.5 in H x 17 in W x 18 in D)
Weight: 10.43 kg (23 lb)

Ordering Information

Model

343A DC Voltage Calibrator

Included with Instrument
One-year product warranty, line cord, Instruction manual, and Certificate of Calibration Practices.

Accessories (Also see Section 19)
MEE-7001 3½" Rack Mount Kit

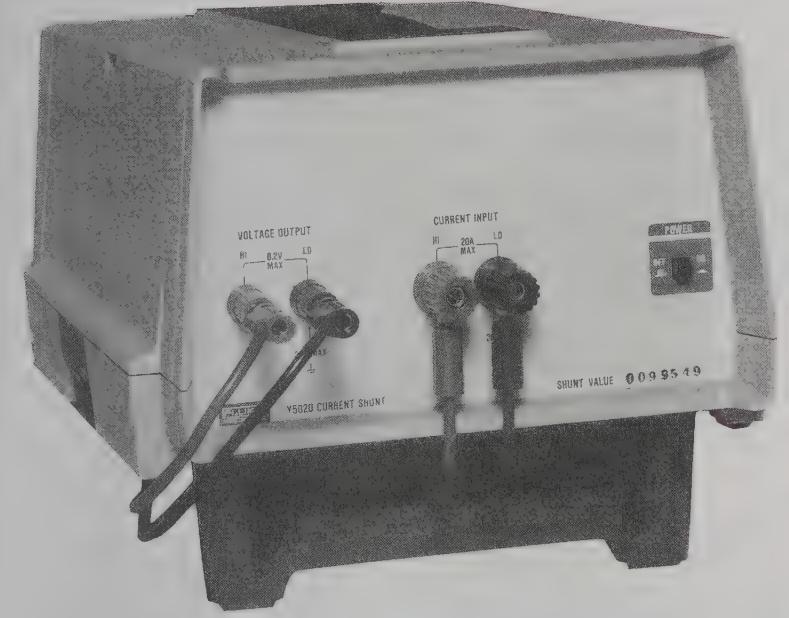
Manual
343A Instruction*

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.



(NSN 6625-01-278-2847) **Y5020**

Y5020 AC or DC Current Shunt

- Rated to 20A dc to 5 kHz
- 100 ppm uncertainty
- 10 milliohms nominal resistance
- Less than 250 mV burden

The Y5020 Current Shunt is a very stable, non-inductive, four-terminal resistive current shunt. It may be used to verify the accuracy of the 5220A Transconductance Amplifier or other current calibrators. It is an inexpensive method of accurately measuring current up to 20A, from dc to 5 kHz. The 0.01Ω nominal resistance creates less than 250 mV burden. A forced-air cooling fan stabilizes internal ambient temperature during use.

Specifications

The following specifications apply for one year, provided the Y5020 is operated with its cooling fan in ambient temperatures from 18°C to 28°C. Voltage terminals must be connected to a measurement circuit with an input resistance of 1 MΩ or greater and a capacitance of 500 pf or less.

Nominal Resistance: 0.01Ω ±1%
Uncertainty:* Direct current, ±100 ppm; alternating current, ±(150 ppm + 120 ppm x frequency in kHz) relative to direct current specification
Stability: Less than 20 ppm resistance change in six months
Maximum Current: 20A direct current or rms alternating current
Burden Voltage: Less than 250 mV at 20A
Temperature Coefficient: Less than 20 ppm/°C; 0°C to 18°C and 28°C to 50°C
Power Coefficient: Less than 12 ppm per watt
Operating Temperature: 0°C to 50°C ambient
Storage Temperature: -40°C to 70°C
Input Power:** 115V or 230V ac ±10%, 11W
Size: 12.7 cm H x 20.5 cm W x 3.6 cm D (5.0 in H x 8.0 in W x 12.9 in D)

**Referenced to the certified absolute value of shunt resistance stamped on the front panel*

***For cooling fan. Specify 115V or 230V when ordering.*

Ordering Information

Model

Y5020* Current Shunt

**Specify supply voltage (e.g., Y5020-115 or Y5020-230)*

Included with Instrument

One-year product warranty, cord set and Instruction manual.

Manual

Y5020 Instruction*

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty

One-year product warranty.

MET/TRACK Metrology Property Management Software

NEW

NEW! Version 3.1

- Network capable
- Calibration by interval or by usage
- Enhanced customization
- New manual

Designed Precisely for Metrology Asset Management

MET/TRACK™ is a software package designed specifically for metrology property management on MS-DOS compatible computers. Through structured data collection and powerful searching, sorting and reporting capabilities, MET/TRACK fully supports your traceability requirements, including ISO 9000 and MIL-STD-45662A. As part of Fluke's Metrology Management Software family, MET/TRACK works with MET/CAL™ Calibration Software to form a complete calibration and asset management system.

Because the task of property management is ideally suited to automation, most such systems are created by data processing personnel for use on large mainframes or minicomputers. They aren't well documented and don't usually meet all the metrology needs of the user. Adding requirements, like special reports, is often expensive and time consuming, and must be implemented by experienced programmers who rarely understand the metrology department's unique needs.

MET/TRACK takes advantage of the high performance of today's personal computers and networking technology to provide a powerful tool for metrology property management, locally, in your lab. MET/TRACK was designed by metrologists for the metrology environment, so information is collected, maintained and reported consistent with the audit requirements you face. It is logically structured around the flow of assets through the calibration recall process. And it is flexible, so it can be adapted to meet your unique property management needs. Plus, MET/TRACK is easy to use. Familiar calibration/metrology terminology is employed throughout.

Supports Your ISO 9000 Traceability Requirements

MET/TRACK is designed to support the traceability requirements of ISO 9001, 4.11b. It checks for out-of-date conditions when entering standards, and checks for appropriate levels of standards. And you can generate forward and reverse traceability and "found out-of-tolerance" reports, per ISO 9001, 4.11g.

Helps Control Your Operating Expenses

MET/TRACK can help you control and even reduce the cost of managing metrology assets. By running it on a PC in your lab, you are freed from MIS on-line expenses. Retrieving information can be as simple as filling in blanks and printing a report. So you don't have to depend on your data processing department to get the information you need.

Provides the Metrics Necessary to Improve Quality

In today's quality conscious business environment, MET/TRACK makes it easy to generate the metrics to support continuous improvement of processes. MET/TRACK provides powerful tools for immediate access to:

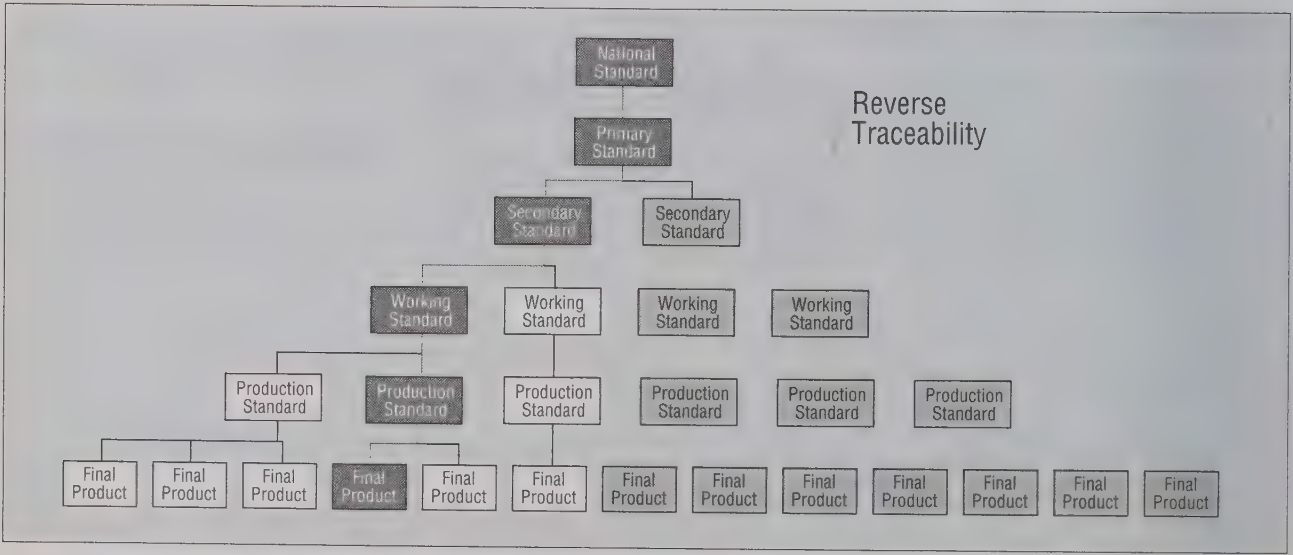
- Workload assignment information
- Technician schedules
- Technician productivity and efficiency statistics
- Repair and calibration turnaround time
- Overdue backlog
- Total calibration and repair hours by user, technician
- Equipment location and tracking
- Cost of ownership by asset

Assures Data Integrity and Quality

Your metrology asset data base is only as good as the information you collect. So MET/TRACK is structured to assure that the right data is collected the same way every time.

Comprehensive data validation assures that information, such as manufacturer, model and description, is collected consistently. An operator can "pop-up" valid choices, eliminating the need to type in the entry. Validation also checks internal linkages to assure that the proper date format is being used, or that the recorded calibraton date is not earlier than the date the asset arrived in the lab. And you define data validation parameters for your lab according to your needs and the terminology you use.

You may designate key data fields as required, forcing data to be entered. You may specify default data to be entered in selected fields. And in Version 3.1, you may link validation files so that entering one field automatically causes other fields to be filled correctly. For example, entering "8840A" as Model could automatically cause "Fluke" to load as Manufacturer and "DMM" to load as Description.


National Standard
Reverse Traceability
Primary Standard
Secondary Standard
Secondary Standard
Working Standard
Working Standard
Working Standard
Working Standard
Production Standard
Production Standard
Production Standard
Production Standard
Production Standard
Production Standard
Final Product
Final Product
Final Product
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Final Product
Final Product
Final Product
Final Product

MET/TRACK supports forward and reverse traceability.

MET/TRACK Metrology Property Management Software

Keeps You Flexible and Productive

MET/TRACK is designed to operate in your metrology department, under your local control on your PC so that you can access information quickly, confidently and with ease.

You may conduct searches for asset information on-screen. Report a wide variety of information using one of the 90+ reports included with MET/TRACK. Or create custom reports using MET/TRACK's Report Writer. These reports may be printed to the screen, to a printer, or to a file.

MET/TRACK's merge data bases provide additional flexibility by allowing you to collect information in text files you create, linked to fields in MET/TRACK. There's no limit to the number of fields or records in a merge data base, and that information can be included when you view or print data, or used in selects and sorts for reports.

Adapts To the Way You Work

Now it's easier than ever to modify MET/TRACK to meet your specific needs. A new on-screen editor, EDMTCUST, allows you to quickly and easily modify every MET/TRACK field to control:

- Field title
- Field suppression
- Whether data is required, on initial (first time) or normal (subsequent) access
- Which operator levels may access the field, on initial or normal access
- Default data to be entered, on initial or normal access
- Linkage via validation to other fields

MET/TRACK 3.1 now includes five new user-designed fields. Even MET/TRACK's menus and Help screens may be customized to meet your needs.

Shares Information Freely

MET/TRACK is network aware, allowing multiple operators to access the system simultaneously over a local area network (LAN). The main data files reside on the network server, while each MET/TRACK-ND (node) serves as a PC workstation running a copy of the software. MET/TRACK supports Novell NetWare and any other PC LAN that permits use of MS-DOS file services.

MET/TRACK also interfaces easily with other corporate systems. MET/TRACK can import or export any MS-DOS ASCII file. Free-form, fixed and page modes allow you to import practically any format.

It is also possible to make date or temperature conversions or perform arithmetic calculations on data as it is imported. Data validation is active during the process. Imported data that doesn't match your validation requirements is logged to an error file along with an explanation of the problem.

MET/TRACK provides a high degree of flexibility when exporting data, allowing you to save information in ASCII text in virtually any file format.

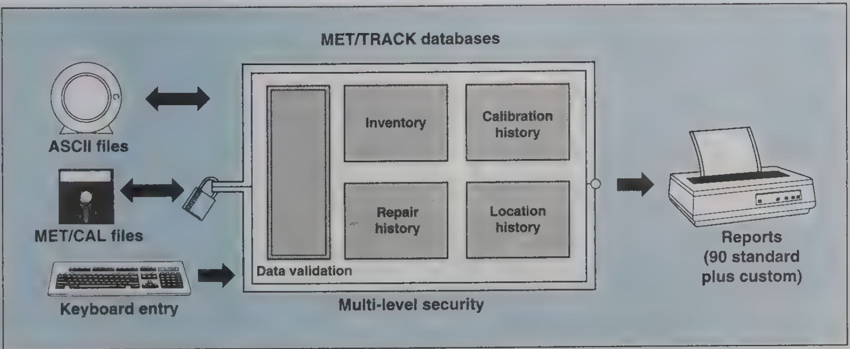
Included with MET/TRACK are format files that simplify transfer of data between MET/TRACK and MET/CAL Calibration Software.

Assures Timely Recall

MET/TRACK makes possible the recall of calibration assets on a disciplined schedule. That, in turn, controls turnaround time, system downtime, and backup equipment requirements. And MET/TRACK collects the data which may be used to justify a calibration interval increase. All of which means you can effectively control calibration costs.

Handles Many Types of Assets

Many assets, such as electronic instruments, have calibration intervals based on time periods, e.g. days, weeks, or months. MET/TRACK always handled these assets well. But many physical or dimensional assets are recalibrated according to number of uses. Now, MET/TRACK 3.1 handles those assets, too. MET/TRACK now allows you to declare a different interval type and period for each individual asset. Two new interval types have been added: U for uses and N for never.



MET/TRACK collects, stores, and integrates data for all inventory, calibration, location and repair histories.

Controls System Access

MET/TRACK's five levels of operator authority plus user name and password security provide you with complete control over who can access the information on your system. Security levels range from "look-only" to "system manager". Sensitive data is encrypted to allow viewing by appropriate levels only.

Access to MET/TRACK is additionally protected by a hardware key. To add or change data, a key is required. However, at the system manager's election, "look-only" access can be enabled with user name and password only.

Allows Quick Startup, Early Productivity

A self-guiding tutorial (Sample Version) and context sensitive help allow you to quickly become productive in your use of MET/TRACK. Complete, concise documentation is included.

In North America, MET/SUPPORT is available including toll-free phone line, 24-hour fax, and 24-hour bulletin board services designed to keep you on track.

Finally, an optional MET/TRACK training course is available at sites around the world.

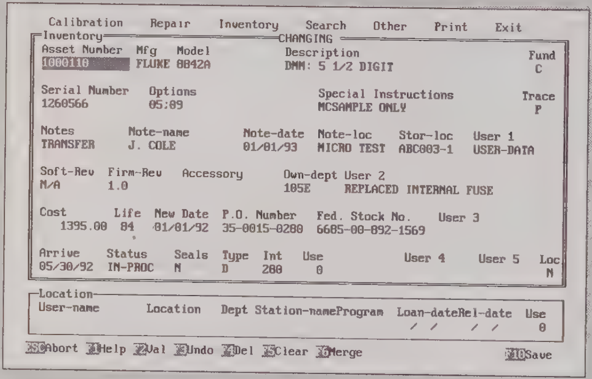
ARE YOU READY FOR
ISO
9000

MET/TRACK provides a cost-effective solution to management of metrology assets. It also specifically addresses out-of-tolerance reporting and reverse traceability needs cited in ISO 9001, paragraph 4.11g and ISO 9004, paragraph 13.4.

MET/TRACK Metrology Property Management Software

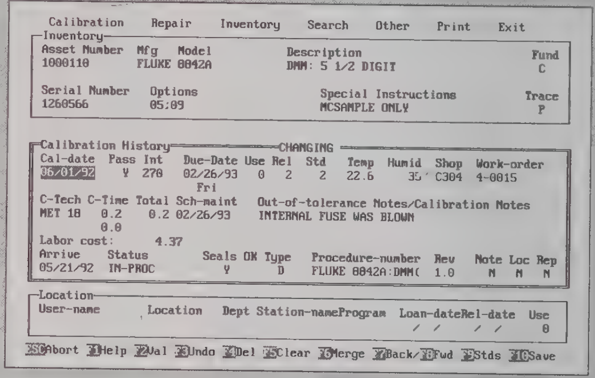
Structured for the way you work. MET/TRACK is structured after the flow of assets through the calibration laboratory. Data is arranged in four major categories: Inventory, Calibration History, Repair History and Location History.

DATA



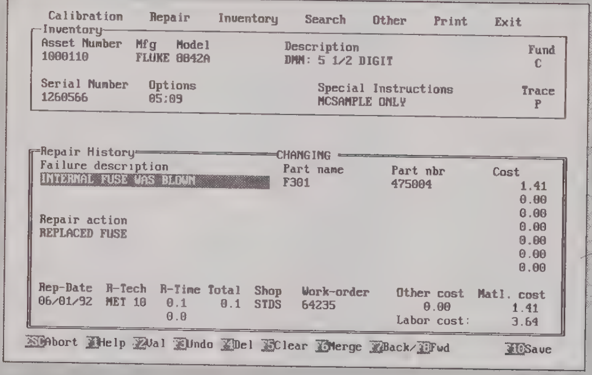
```
  Calibration   Repair   Inventory   Search   Other   Print   Exit
 Inventory                          CHANGING
 Asset Number  Mfg   Model            Description                        Fund
 1000110       FLUKE 8842A            DMM: 5 1/2 DIGIT                     C

 Serial Number  Options                  Special Instructions            Trace
 1260566        05:09                    MCSAMPLE ONLY                     P

 Notes        Note-name       Note-date  Note-loc    Stor-loc   User 1
 TRANSFER     J. COLE         01/01/93   MICRO TEST  ABC003-1   USER-DATA

 Soft-Rev  Firm-Rev  Accessory     Own-dept User 2
 N/A       1.0                     105E     REPLACED INTERNAL FUSE

 Cost       Life  New Date  P.O. Number  Fed. Stock No.     User 3
   1395.00  84    01/01/92  35-0015-0280 6685-00-892-1569

 Arrive    Status    Seals  Type  Int  Use            User 4    User 5   Loc
 05/30/92  IN-PROC   N      D     280    0                                N
 Location
 User-name      Location   Dept Station-nameProgram  Loan-dateRel-date   Use
                                                       / /      / /        0
ESCAbort F1Help F2Val F3Undo F4Del F5Clear F6Merge                  F10Save
```

Inventory Screen



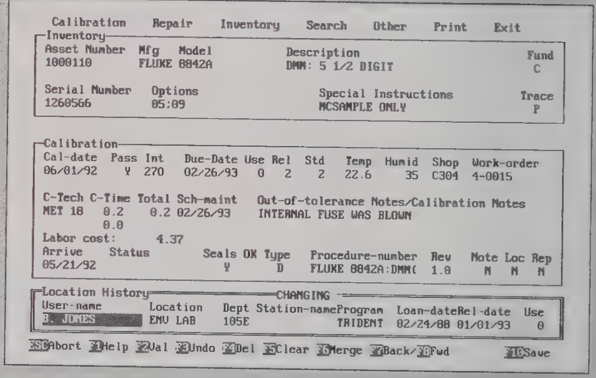
```
  Calibration   Repair   Inventory   Search   Other   Print   Exit
 Inventory
 Asset Number  Mfg   Model            Description                        Fund
 1000110       FLUKE 8842A            DMM: 5 1/2 DIGIT                     C

 Serial Number  Options                  Special Instructions            Trace
 1260566        05:09                    MCSAMPLE ONLY                     P

 Calibration History                CHANGING
 Cal-date  Pass Int   Due-Date Use Rel  Std   Temp  Humid  Shop  Work-order
 06/01/92    Y  270   02/26/93  0   2    2    22.6     35  C304  4-0015
                         Fri
 C-Tech C-Time Total Sch-maint   Out-of-tolerance Notes/Calibration Notes
 MET 18   0.2    0.2 02/26/93    INTERNAL FUSE WAS BLOWN
          0.0
 Labor cost:      4.37
 Arrive    Status          Seals OK Type   Procedure-number  Rev   Note Loc Rep
 05/21/92  IN-PROC            Y       D    FLUKE 8842A:DMM(  1.0     N   N   N
 Location
 User-name      Location   Dept Station-nameProgram  Loan-dateRel-date   Use
                                                       / /      / /        0
ESCAbort F1Help F2Val F3Undo F4Del F5Clear F6Merge F7Back/F8Fwd F9Stds F10Save
```

Calibration History Screen



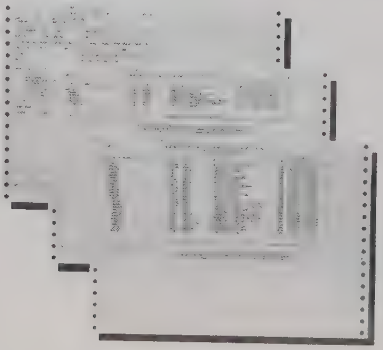
```
  Calibration   Repair   Inventory   Search   Other   Print   Exit
 Inventory
 Asset Number  Mfg   Model            Description                        Fund
 1000110       FLUKE 8842A            DMM: 5 1/2 DIGIT                     C

 Serial Number  Options                  Special Instructions            Trace
 1260566        05:09                    MCSAMPLE ONLY                     P


 Repair History                     CHANGING
 Failure description               Part name       Part nbr        Cost
 INTERNAL FUSE WAS BLOWN           F301            475004              1.41
                                                                       0.00
 Repair action                                                         0.00
 REPLACED FUSE                                                         0.00
                                                                       0.00
                                                                       0.00
                                                                       0.00
 Rep-Date  R-Tech  R-Time Total  Shop  Work-order    Other cost  Matl. cost
 06/01/92  MET 10   0.1     0.1  STDS  64235            0.00        1.41
                    0.0                              Labor cost:    3.64
ESCAbort F1Help F2Val F3Undo F4Del F5Clear F6Merge F7Back/F8Fwd     F10Save
```

Repair History Screen



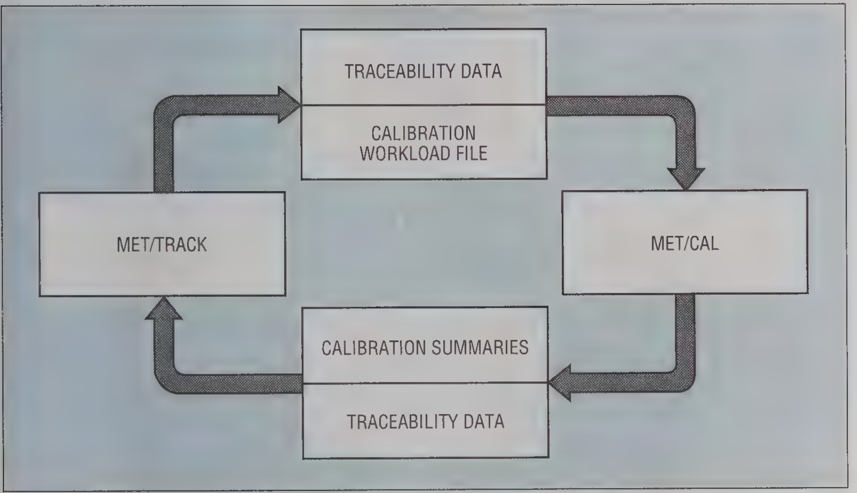
```
  Calibration   Repair   Inventory   Search   Other   Print   Exit
 Inventory
 Asset Number  Mfg   Model            Description                        Fund
 1000110       FLUKE 8842A            DMM: 5 1/2 DIGIT                     C

 Serial Number  Options                  Special Instructions            Trace
 1260566        05:09                    MCSAMPLE ONLY                     P

 Calibration
 Cal-date  Pass Int   Due-Date Use Rel  Std   Temp  Humid  Shop  Work-order
 06/01/92    Y  270   02/26/93  0   2    2    22.6     35  C304  4-0015

 C-Tech C-Time Total Sch-maint   Out-of-tolerance Notes/Calibration Notes
 MET 18   0.2    0.2 02/26/93    INTERNAL FUSE WAS BLOWN
          0.0
 Labor cost:      4.37
 Arrive    Status          Seals OK Type   Procedure-number  Rev   Note Loc Rep
 05/21/92                     Y       D    FLUKE 8842A:DMM(  1.0     N   N   N
 Location History                   CHANGING
 User-name     Location   Dept Station-nameProgram  Loan-dateRel-date   Use
 B. JONES      ENV LAB    105E              TRIDENT 02/24/88 01/01/93   0
ESCAbort F1Help F2Val F3Undo F4Del F5Clear F6Merge F7Back/F8Fwd     F10Save
```

Location History Screen



More than 90 standard reports cover the entire range of reporting requirements.

MET/TRACK Metrology Property Management Software



MET/TRACK and MET/CAL are designed to exchange results information and allow you to schedule your workload.

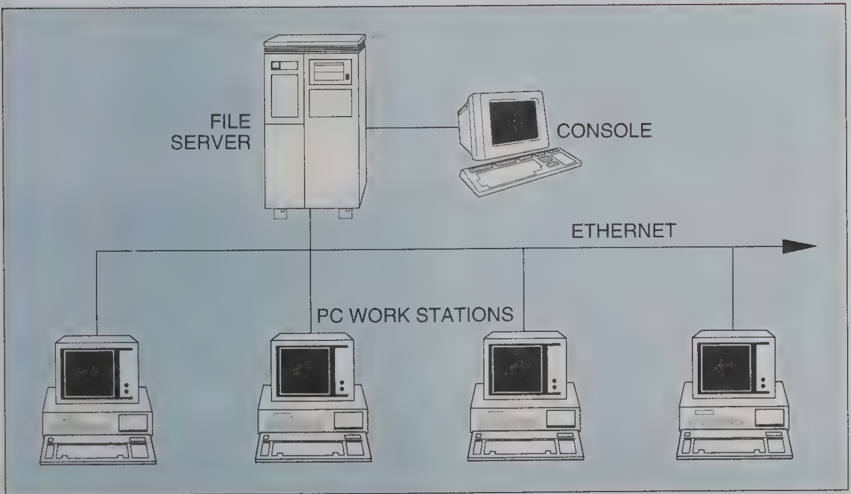
Hardware and Software Requirements (minimum)

80286 (IBM PC AT, PS/2, or 100% compatible)
640 kB RAM
MS-DOS 3.3
Hard disk drive (size determined by formula)
Monochrome monitor
Parallel port (required)
Printer
Tape back-up (recommended)
Network interface card (not required for single station use)

Additional Requirements

A PC LAN system that permits use of MS-DOS file services is needed to run MET/TRACK and its additional MET/TRACK-NDs.

A LAN consists of a Network Operating System (NOS) and a file server. The server hard disk capacity requirements for MET/TRACK can be determined by the formula to the right. The file server should be connected to an uninterruptible power supply (UPS). At least one LAN workstation should contain a tape back-up unit to back-up files on the server.



MET/TRACK in local area network.

How to Estimate Hard Disk Storage

A storage estimate calculated using the formula should be con-sidered an absolute minimum for MET/TRACK data base files. To ensure sufficient storage for other tasks such as printing reports to disk, the estimate should be doubled.

$S = I\,(1730 + 320C + 582R + 104L)(1+r)^n$

where: S = bytes of storage required
I = total number of assets (both active and inactive)
n = number of years of data to be retained
C = average number of calibrations per asset per year
R = average number of repairs per asset per year
L = average number of location changes per asset per year
r = annual rate of growth expressed as a decimal

Try MET/TRACK Free!

For a free sample copy of MET/TRACK, call your local Fluke representative, or in North America, dial **1-800-44-FLUKE.** Ask for the MET/TRACK Sample Version, J0378.

Ordering Information

Models

MET/TRACK
MET/TRACK-ND LAN Workstation
MET/TRACK-U3 Upgrade to Version 3.1
MET/TRACK, Training Course:
  TRC 1007 MET/TRACK Training

MET/CAL Calibration Software

NEW

NEW! Version 3.1

- 5790A, SG5030, and PM 6680 drivers
- New procedures
- New user's manual

When Quality Matters...

Today's intense international competition places a strong focus on quality. Every aspect of your operation affecting the quality of delivered products comes under scrutiny – including the way your test and measurement equipment is maintained and calibrated. But maintaining and calibrating your equipment, and generating accurate and timely reports about the process, can be difficult. Users can't afford extended downtime while their equipment is in the cal lab. Finding qualified personnel to perform calibrations is a problem. And you're under tremendous pressure to control costs as well as quality.

MET/CAL Can Help

Using a personal computer as the calibration system controller, MET/CAL calibrates a broad selection of instruments and automates your information collection and reporting.

With MET/CAL, you can:

- Generate, check, and document calibration procedures. You reduce the time spent on calibration and documentation, which in turn reduces equipment downtime.
- Execute calibration procedures. With MET/CAL, even inexperienced operators can deliver consistent, repeatable calibrations in record time. And MET/CAL's computer-aided and closed-loop modes accommodate instruments with or without a GPIB/IEEE-488* interface.
- Document results with calibration certificates, summaries, and detailed reports. MET/CAL helps you address the ISO 9000 requirements dealing with traceability, adequacy, procedure documentation, out-of-tolerance reporting, and record keeping.

Easy Procedure Generation

To simplify the process of writing calibration procedures, MET/CAL uses a full set of easy-to-use Function Selection Codes (FSCs) to control all parts of the system. FSCs serve as "procedure building blocks" that you can arrange in a variety of ways to meet your calibration requirements. FSCs control instruments, generate operator prompts, establish or change default conditions, evaluate test results, run DOS programs from within a procedure, access device dependent functions, or search for the IEEE-488 address of the instrument under test.

Generating a test is as simple as entering the name of a calibrator FSC, an output parameter and a tolerance. MET/CAL handles the rest. For example, the FSC 5700 defines the test conditions, prompts the operator, measures and computes unit under test (UUT) error using the Fluke 5700A Calibrator, and reports the result.

MET/CAL automatically checks procedures for errors as they are compiled. Using the specification file for the instruments in your calibration system, it also compares the tolerance you select for the test with the performance specifications for the calibration instruments used. If the test uncertainty ratio (TUR) for a test is below what you have selected for your system, MET/CAL warns you.

FSCs add flexibility to your system. For example, the IEEE FSC permits you to access all the functions of virtually any IEEE-controllable instrument via device dependent commands, while the PORT FSC allows access to RS-232C devices.

Fast, Simple Operation

When you run a calibration procedure on a Fluke automated calibration system, MET/CAL does the hard work. It not only leads the operator through the procedure itself, but also handles many of the tasks that the operator usually performs, from taking measurements to calculating and recording the error of the UUT. Closed-loop or computer-aided calibration modes accommodate UUTs with or without a GPIB/IEEE-488 interface.

Closed-loop calibration. If the instrument to be calibrated has an IEEE-488 interface, using closed-loop calibration can reduce calibration time. MET/CAL prompts the operator to connect the necessary test leads, then sets the UUT to the proper range and function, applies the output from the calibration instruments, evaluates the UUT reading, then proceeds to the next step until each range and function is verified – all with little or no operator involvement.

If the UUT uses software adjustment (for example, the Fluke 8840 Series), MET/CAL can instruct the system to make necessary adjustments by storing correction factors in the UUTs non-volatile memory. Otherwise, MET/CAL advises the operator of the required adjustments. High resolution diagrams or illustrations can be included in MET/CAL procedures to show the operator where to make connections or adjustments.

Computer-aided calibration. For calibrating instruments that do not have a GPIB/IEEE-488 interface, MET/CAL prompts the operator through the calibration process, performs the necessary calculations, and helps the operator to make the actual adjustments to the UUT.

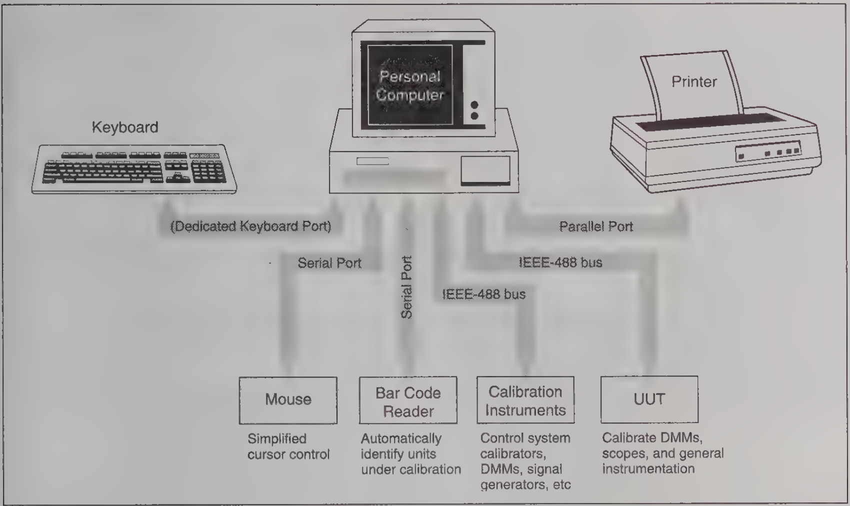
Step-by-step instructions, diagrams, even illustrations using computer graphics, are presented on the PC display to guide the operator through each task, so that even inexperienced operators can complete complex calibration procedures quickly with very little training. And because the computer controls the procedure, the possibility of operator errors is greatly reduced.

* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

How MET/CAL Helps with ISO 9000 Compliance

Documents upward traceability	Complies with ISO 9001, 4.11b; traceability to national standards
Preserves calibration records	Complies with ISO 9001, 4.11f; calibration records
Documents calibration procedures	Complies with ISO 9001, 4.11c; documented cal procedures
Flags out-of-tolerance points	Complies with ISO 9001, 4.11g; out-of-tolerance conditions
Calculates Test Uncertainty Ratio (TUR)	Complies with ISO 9001, 4.11d; adequacy of standards
Logs environmental conditions	Complies with ISO 9001, 4.11h; environmental conditions

ARE YOU READY FOR
ISO
9000


Personal Computer
Printer
Keyboard
(Dedicated Keyboard Port)
Parallel Port
Serial Port
Serial Port
IEEE-488 bus
IEEE-488 bus
Mouse
Simplified cursor control
Bar Code Reader
Automatically identify units under calibration
Calibration Instruments
Control system calibrators, DMMs, signal generators, etc
UUT
Calibrate DMMs, scopes, and general instrumentation

Typical MET/CAL system

Flexible Test Reporting

When a calibration procedure is complete, you can print the results to the computer's screen, to a printed report, or to a file. Standard templates allow you to generate calibration certificates, calibration summaries, detailed results reports, as-found/as-left reports, and test uncertainty ratio (TUR) reports. Optional templates are provided for alternative reports. And you can define your own format for report headers and results data.

In addition, a test summary and traceability data are available in a Standard Data Format (SDF) delimited file for use with data management software, such as Fluke MET/TRACK Metrology Property Management software.

All of the above outputs may be selected via a preset post-test routine, which automatically generates the screens, paper reports, or archive files of your choice.

MET/CAL Features

- Drives a wide range of popular calibration instruments. With enhanced IEEE FSC, controls virtually any IEEE instrument.
- Delivers automatic calculation of error, percent of tolerance, and Test Uncertainty Ratio (TUR).
- Provides a large installed base of established users for exchange of procedures, tips, application information.
- Instantly disconnects stimulus instruments upon system interrupt, which protects you from hazardous voltages.
- Promotes quick startup with a complete tutorial, context sensitive help, complete manuals, and phone/fax/bulletin board support.
- Permits in-situ calibration when used with an environmentally tolerant calibrator such as the Fluke 5700A.
- Supports quick expansion or reconfiguration. Supported instruments can be added at any time.
- Permits three input modes. Select GO/NO GO, slew or keyboard responses to an instrument test.

New! in MET/CAL 3.0

- Control an even wider variety of calibration instruments, including the Fluke 5790A AC Measurement Standard, Tektronix SG5030 Leveled Sinewave Generator, and Philips PM 6680 Counter.
- Execute new procedures for the Fluke 93/95/97 ScopeMeter, Fluke 10/11/12 Multimeters, Fluke 31/33 Clampmeter, Fluke 86/88 Automotive meters, Fluke 29/79 Multimeters, Fluke 5700A Calibrator (AC verification), and virtually all Fluke handhelds. Procedures utilize the 5700A Calibrator. Where appropriate, 5100-based procedures have also been provided.
- Re-order your procedure directory with the new PRODIRED utility.
- Generate procedures quickly for assets like micrometers or pressure gauges with the OP utility.
- Calculate TURs for user defined instruments.
- Find answers fast in the new manual set, featuring a new and improved index, glossary, and Getting Started guide.

Powerful MET/CAL Extras

Example procedures. A number of example procedures are included with MET/CAL. Use them as is or as a guide for creating new procedures. You may also modify them to fit your particular requirements.

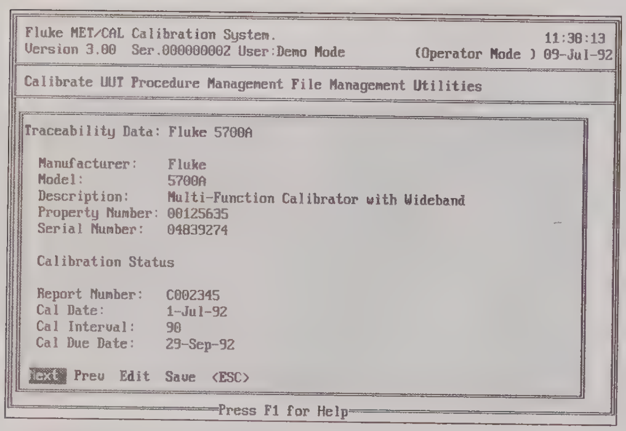
Instrument	Prompted Ver	Prompted Adj	Closed-loop Ver	Closed-loop Adj
ScopeMeters				
Fluke 93/95/97			●	●
Calibrators				
Fluke 5700A (AC & -03)			●	
Dataloggers				
Fluke 2620A Hydra			●	●
Fluke 2625A Hydra			●	●
Meters				
Fluke 10/11/12	●	●		
Fluke 21/23/ 21-2/23-2	●	●		
Fluke 25/27/8025B	●	●		
Fluke 29/79	●	●		
Fluke 31/33	●	●		
Fluke 37	●	●		
Fluke 45	●	●		
Fluke 73/75/77	●	●		
Fluke 70-2/73-2/ 75-2/77-2	●	●		
Fluke 83/85/87	●	●		
Fluke 86/88	●	●		
Fluke 8000A	●	●		
Fluke 8020B	●	●		
Fluke 8021B	●	●		
Fluke 8022B	●	●		
Fluke 8024B	●	●		
Fluke 8026B	●	●		
Fluke 8050A	●	●		
Fluke 8060A/8062A	●	●		
Fluke 8840A/8842A			●	●
HP 3457A			●	
HP 3478A			●	●
Keithley 197	●		●	
Keithley 199			●	●
PM 2535			●	
Universal Decade Box	●			
Oscilloscopes				
PM 3050	●	●	●	●
PM 3055	●	●	●	●
Tektronix 2445A	●	●	●	●

Procedures included with MET/CAL. Meters shown in bold have both 5100-based and 5700-based procedures. Others have only the 5700-based procedure. Default amplifiers are the 5205A (5100) or the 5725A (5700). Default scope calibrator is the CG 5011.

Built-in editor. MET/CAL includes a powerful full screen editor for creating or revising procedures. Several test steps are shown at one time, so you can see the relationship of one step to another. Three test modes are included to assure the procedure is having the expected effect on instruments in the system. Single steps or complete procedures can be test run in trace, debug and free run modes. A demo mode permits procedures under development to be run without system instruments present.

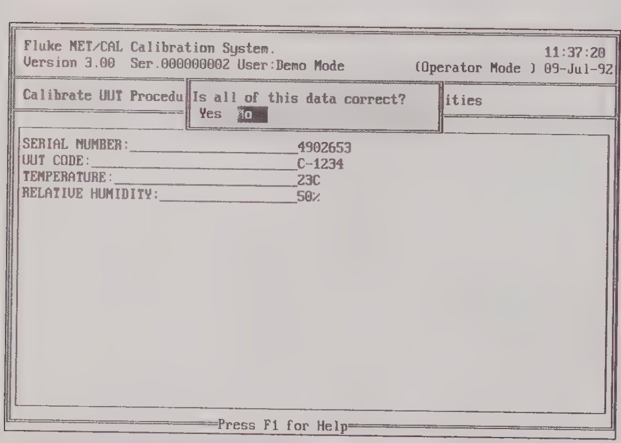
You may also use DOS-based text editors with MET/CAL. Once written, a procedure is retrieved with the MET/CAL editor for error checking, testing, and compiling.

MET/CAL Calibration Software



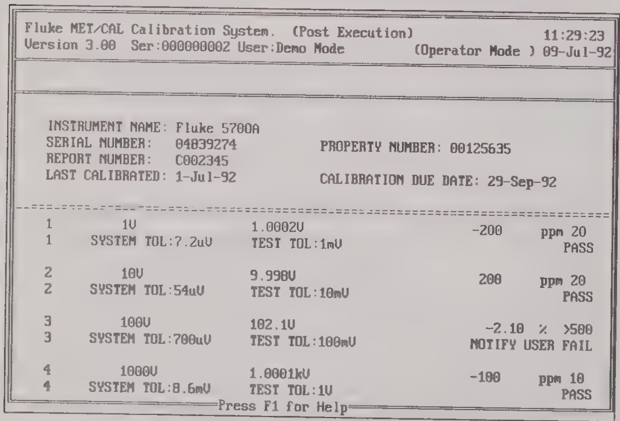
```
Fluke MET/CAL Calibration System.                                 11:30:13
Version 3.00  Ser.000000002 User:Demo Mode        (Operator Mode ) 09-Jul-92

Calibrate UUT Procedure Management File Management Utilities

Traceability Data: Fluke 5700A

  Manufacturer:    Fluke
  Model:           5700A
  Description:     Multi-Function Calibrator with Wideband
  Property Number: 00125635
  Serial Number:   04839274

  Calibration Status

  Report Number:   C002345
  Cal Date:        1-Jul-92
  Cal Interval:    90
  Cal Due Date:    29-Sep-92

 Next  Prev  Edit  Save  <ESC>
                    Press F1 for Help
```

Traceability information is captured, per ISO 9001, 4.11b.



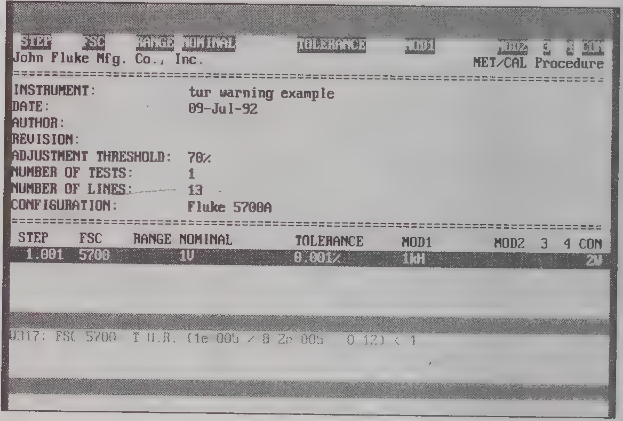
```
Fluke MET/CAL Calibration System.                                 11:37:20
Version 3.00  Ser.000000002 User:Demo Mode        (Operator Mode ) 09-Jul-92

Calibrate UUT Procedu Is all of this data correct?  ities
                       Yes  No

SERIAL NUMBER:_____________________4902653
UUT CODE:__________________________C-1234
TEMPERATURE:_______________________23C
RELATIVE HUMIDITY:_________________50%

                    Press F1 for Help
```

MET/CAL prompts for environmental conditions, which help demonstrate environmental control (ISO 9001, 4.11h).



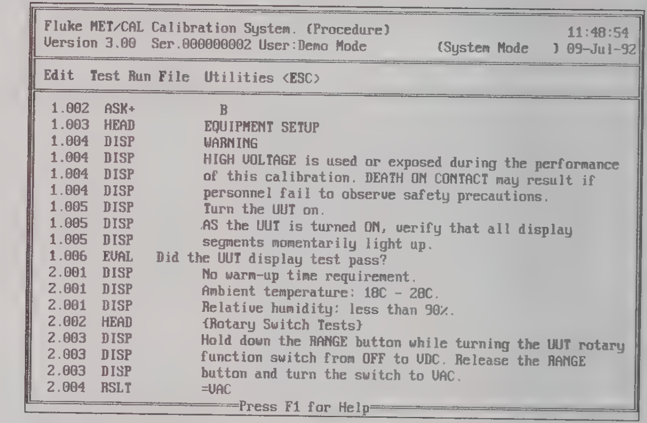
```
Fluke MET/CAL Calibration System.  (Post Execution)               11:29:23
Version 3.00  Ser:000000002 User:Demo Mode        (Operator Mode ) 09-Jul-92

   INSTRUMENT NAME: Fluke 5700A
   SERIAL NUMBER:   04839274           PROPERTY NUMBER: 00125635
   REPORT NUMBER:   C002345
   LAST CALIBRATED: 1-Jul-92           CALIBRATION DUE DATE: 29-Sep-92
============================================================================
   1        1V            1.0002V                    -200      ppm 20
   1     SYSTEM TOL:7.2uV   TEST TOL:1mV                           PASS

   2        10V           9.998V                      200      ppm 20
   2     SYSTEM TOL:54uV    TEST TOL:10mV                          PASS

   3        100V          102.1V                     -2.10  %  >500
   3     SYSTEM TOL:700uV   TEST TOL:100mV             NOTIFY USER FAIL

   4        1000V         1.0001kV                   -100      ppm 10
   4     SYSTEM TOL:8.6mV   TEST TOL:1V                            PASS
                    Press F1 for Help
```

Complete results records help you identify out-of-tolerance conditions (ISO 9001, 4.11g) and satisfy calibrations records requirements (ISO 9001, 4.11f).



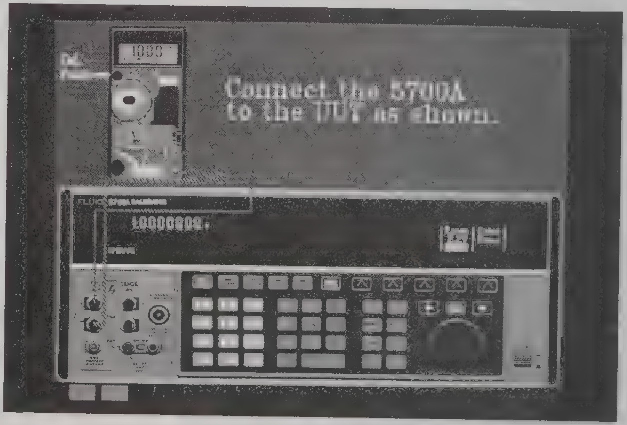
```
STEP    FSC    RANGE NOMINAL          TOLERANCE      MOD1          MOD2  3  4 CON
John Fluke Mfg. Co., Inc.                                          MET/CAL Procedure
=====================================================================================
INSTRUMENT:                 tur warning example
DATE:                       09-Jul-92
AUTHOR:
REVISION:
ADJUSTMENT THRESHOLD:       70%
NUMBER OF TESTS:            1
NUMBER OF LINES:            13
CONFIGURATION:              Fluke 5700A
=====================================================================================
 STEP     FSC    RANGE NOMINAL          TOLERANCE      MOD1          MOD2  3  4 CON
   1.001  5700         1V               0.001%         1kH                       2W

W317: FSC 5700  T.U.R. (1e 005 / 8 2e 005   0 12) < 1
```

Flagging of Test Uncertainty Ratios helps demonstrates adequacy of standards per ISO 9001, 4.11a, d.



```
Fluke MET/CAL Calibration System. (Procedure)                     11:48:54
Version 3.00  Ser.000000002 User:Demo Mode         (System Mode  ) 09-Jul-92

Edit  Test Run File  Utilities <ESC>

  1.002  ASK+            B
  1.003  HEAD          EQUIPMENT SETUP
  1.004  DISP          WARNING
  1.004  DISP          HIGH VOLTAGE is used or exposed during the performance
  1.004  DISP          of this calibration. DEATH ON CONTACT may result if
  1.004  DISP          personnel fail to observe safety precautions.
  1.005  DISP          Turn the UUT on.
  1.005  DISP          AS the UUT is turned ON, verify that all display
  1.005  DISP          segments momentarily light up.
  1.006  EVAL      Did the UUT display test pass?
  2.001  DISP          No warm-up time requirement.
  2.001  DISP          Ambient temperature: 18C - 28C.
  2.001  DISP          Relative humidity: less than 90%.
  2.002  HEAD          {Rotary Switch Tests}
  2.003  DISP          Hold down the RANGE button while turning the UUT rotary
  2.003  DISP          function switch from OFF to VDC. Release the RANGE
  2.003  DISP          button and turn the switch to VAC.
  2.004  RSLT          =VAC
                    Press F1 for Help
```

Complete procedure listings help satisfy calibration procedure requirements of ISO 9001, 4.11c.



Connect the 5700A to the UUT as shown.

Complete detailed instructions help comply with the requirements of ISO 9001, 4.11c.

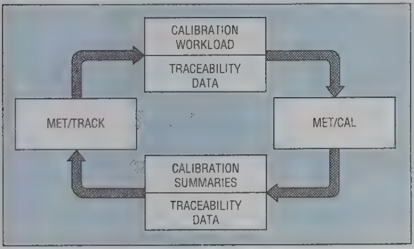
MET/CAL Calibration Software

Off-line edit. The capability to run additional copies of MET/CAL for off-line writing and editing of procedures is included with MET/CAL.

Customization. MET/CAL allows considerable freedom to customize your system environment as well as the results you report. Default system prompts are stored as text files and may be edited to fit the particular needs of your lab. Test result summaries may be customized using up to 20 standards. Because calibration summaries can be stored in a delimited text format, they can be imported by other popular PC software for further analysis.

In combination with Fluke MET/TRACK™ Metrology Property Management Software, MET/CAL helps you manage calibration data to meet ISO 9000 requirements.

Security. To protect your system and procedures, MET/CAL features four modes of operation: system, procedure writer, results, and operator. MET/CAL security allows you to control who uses your system by assigning different levels of access to various personnel. Passwords are assigned using a separate program included on a supplementary diskette.



MET/TRACK and MET/CAL are designed to exchange results information and allow you to schedule your workload.

Supplemental Programs

Several supplemental programs and utilities are included as part of MET/CAL:

- TESTIT is a program that tests and verifies the correct installation of a mouse and its driver, IEEE-488 interface cards, serial ports and operator's aid. It requires a user supplied Fluke 45 or Fluke 8840 Series digital multimeter to test IEEE-488 ports.
- AUTOPRO generates calibration procedures from spreadsheet-style entries of UUT specifications.
- OP generates procedures for physical or dimensional assets, such as pressure guages or micrometers.
- PRODIRED allows you to order the contents of your on-screen procedure directory arbitrarily.

Controller Configurations

Minimum:

- 100% PC-AT compatible 80286 computer (80386 recommended)
- 40M byte hard disk drive (200 Mbyte recommended)
- 640K bytes RAM
- One parallel port
- One serial port (three recommended)
- Two IEEE-488 interface cards
- MS DOS 3.3 or later (5.0 recommended)
- Monochrome adapter and monitor (EGA or VGA graphics adapter and color monitor recommended)

Fluke offers the MET/CAL-K kit for configuring 100% AT compatible computers to run MET/CAL. This kit includes MET/CAL, supplementary programs, IEEE-488 cards, one AC divider, one GPIB cable, and instruction manuals. Your computer must have MS DOS 3.3 or later installed.

Supported Instruments

MET/CAL includes drivers to support the following calibration instrumentation:

- 5700A Calibrator, -03 Wideband option, 5725A Amplifier
- 5790A AC Measurement Standard
- 5100B Series Calibrators, -03 Wideband option
- 5200A Calibrator
- 5205A, 5215A, 5220A Amplifiers
- 5440 Series Calibrators
- 5450A Calibrator
- 6060 Series RF Signal Generators (6080 Series with emulation)
- 8502A, 8505A, 8506A Multimeters
- 8840 Series Multimeters
- 8920 Series Multimeters (with 1120A)
- Tek CG 5011 and CG 5001 Oscilloscope Calibrators
- Tek SG 5030 Leveled Sinewave Generator
- PM 5191 Function Generator
- PM 6666 Counter
- PM 6680 Counter
- Hewlett-Packard 3458A Multimeter

MET/SUPPORT™

Included with MET/CAL is access to MET/SUPPORT, a comprehensive Fluke software support service. MET/SUPPORT provides:

- Fast answers to your questions by toll-free phone hot line, FAX or electronic bulletin board.
- Help installing or using MET/CAL.
- Procedure writing help.
- User information and procedure exchange through the MET/SUPPORT electronic bulletin board.

For more information on MET/CAL, contact your Fluke representative, or call 1-800-44-FLUKE. Ask for MET/CAL Sample Version 3.0 (J0403A). To order MET/CAL, contact your local Fluke representative.

Options

74XXX-014 Lab Cart. A simple, inexpensive way to move your calibration system from place to place. This sturdy, open frame cart has 4" wheels and space for a calibrator, signal generator, controller, monitor and bar code reader. Assembly required.

Scope Calibration

MET/CAL addresses oscilloscope calibration. MET/CAL includes drivers for the Tektronix CG 5011 Programmable Calibration Generator, Tektronix SG 5030 Leveled Sinewave Generator, and the Fluke 6060 Series Signal Generators. Several scope procedures are included with your MET/CAL purchase, and many are available through the MET/SUPPORT bulletin board and the MET/CAL Users Newsletter. To support scope calibrators, Fluke offers the following package.

The **7409B-CG5011 Oscilloscope Calibrator** is a programmable generator for calibration and verification of all major scope parameters; vertical gain, horizontal timing and gain, input amplifier and attenuator compensation, and probe accuracy. With time markers down to .5 ns/division, both analog and digital oscilloscopes are covered. Remote pulse head provides fast rise-time pulses (<150 ps) and permits bandwidth testing of vertical amplifiers. Comparator head permits calibration of built-in scope calibrators. The 7409B-CG5011 consists of:

- Tektronix CG5011 Programmable Calibration Generator with high stability time base
- Output cable assembly 012-0884-00
- Pulse head 015-0611-00
- Comparator head 015-0310-01
- Tektronix TM 5006 Power Module Mainframe, with rear interface, high power fan, three front panel blanks, in desk-top configuration
- Instruction and Service manuals
- Instrument Interface Guide
- Programmer's Reference manual
- GPIB/IEEE-488 Cable (1 meter)
- One-year warranty
- Full calibration documentation

Size: 194 cm H x 445 cm W x 488 cm D (7.6 in H x 17.5 in W x 19.2 in D)
Weight: 18.8 kg (41.5 lb)

For detailed specifications, see Fluke data sheet A0389. Specify line voltage.

Try MET/CAL Free!

For a free sample copy of MET/CAL, call your local Fluke representative. In North America, call 1-800-44-FLUKE. Ask for MET/CAL Sample Version J0403.

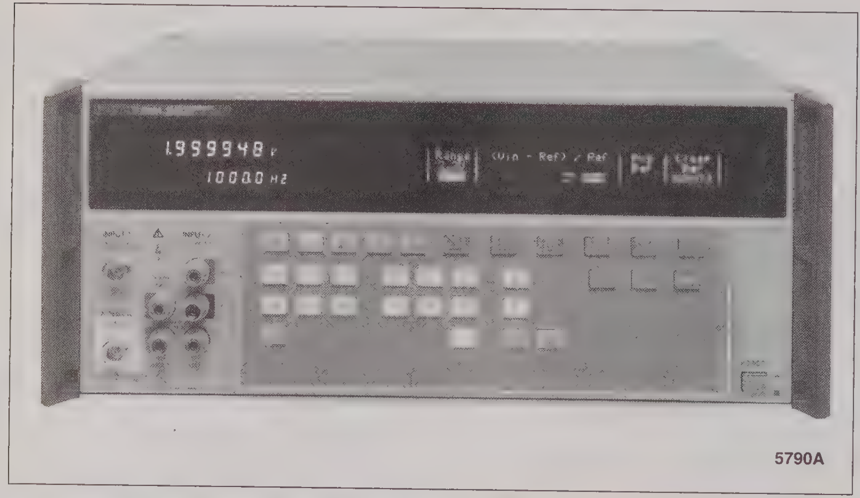
Ordering Information

Models

MET/CAL Calibration Software
MET/CAL-U3 Upgrades previous versions of MET/CAL to MET/CAL 3.1
MET/CAL-K MET/CAL Controller Configuration Kit for IBM-AT compatibles running MS DOS 3.3 or later
7409B-CG5011 Oscilloscope Calibrator
74XXX-014 Lab Cart

5790A

GPIB IEEE-488



5790A

5790A AC Measurement Standard
Automated ac measurement
24 ppm total uncertainty
Traceable to national standards
Voltage range 700 µV to 1000V
Frequency range 10 Hz to 1 MHz
Optional wideband to 30 MHz

Accuracy That's Easy To Use

The 5790A is a complete automated ac measurement standard designed for the most demanding calibration applications. It combines the accuracy you would expect from a thermal transfer standard with the ease-of-use of a digital multimeter. Absolute ac voltage measurement uncertainties are as low as ±24 ppm (one year, 23°C ±5°C). The 5790A is designed to meet the complete ac voltage and wideband verification requirements of the Fluke 5700A, 5100 Series and other calibrators, amplifiers like the 5725A and 5205A, and transfer standards and ac voltmeters.

The 5790A covers an alternating voltage range of 700 µV to 1000V, and a frequency range of 10 Hz to 1 MHz. A wideband voltage option extends frequency range to 30 MHz to meet the calibration requirements of Fluke 5700A and 5100 Series calibrators.

The 5790A is also compatible with Fluke A40 and A40A Current Shunts, which permit you to make ac/dc current transfer measurements up to 20A.

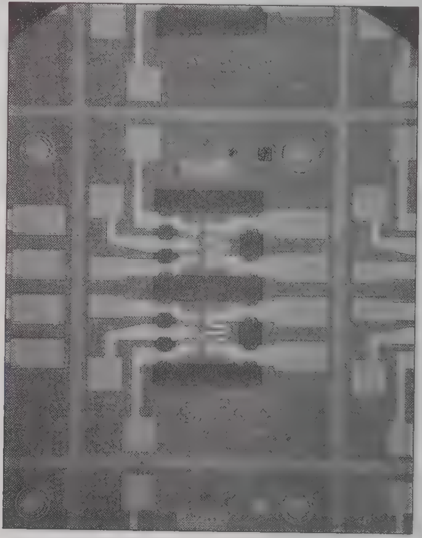
The 5790A may be used alone or as a transfer standard with an external dc source. In either case the normally tedious switching and calculations are performed automatically by the 5790A, and the resulting ac/dc difference is displayed directly on the easy-to-read vacuum fluorescent display.

Precision You Can Depend On

The 5790A is based on the patented Fluke Solid-State Thermal RMS Sensor, which has been proven since 1979 in a variety of Fluke products like the 792A AC/DC Transfer Standard. The Fluke RMS Sensor is a *true* thermal converter, not an electronic converter that calculates the rms value. Because its output voltage is 2V rather than the 7 to 10 mV of traditional thermocouples, the rms sensor exhibits excellent signal-to-noise characteristics and minimal reversal errors. With a higher output voltage, more accurate measurements can be made. And because of its small size, the rms sensor stabilizes quickly and operates over a wide temperature range.

The 5790A also features hermetically sealed thin-film resistor networks to minimize ac measurement errors and enhance temperature coefficient.

The rms sensor and thin-film resistor networks are designed by Fluke to be rugged and reliable. Each is built to exacting standards by the Fluke Microelectronics Division to maintain quality and consistency part after part.



The patented Fluke Solid-State RMS Sensor provides the 5790A with exceptional accuracy and stability, and fast settling time.

Versatility That Keeps You Productive

When you first power up the 5790A, diagnostics verify the instrument's integrity.

The variety of input connections allows you to use the one that best suits your application. There are four sets of input terminals on the 5790A, two Type-N connectors and two sets of five-way binding posts. One Type-N and one set of binding posts are dedicated to the ac measurement and transfer modes. AC or dc voltages may be applied to either input connection over the 5790's full range, allowing you to perform automated ac/dc transfer measurements. The 5790A determines automatically whether the applied voltage is ac or dc.

The second Type-N input connection supports the optional wideband mode, and the second set of binding posts are designed for Fluke A40 Series Current Shunts.

The input connection is selected with the touch of a key on the 5790A front panel. An LED indicates which selection is active.

Whether you are using the 5790A as a voltmeter or a transfer standard, input voltage and frequency are always indicated on the measurement display. In the transfer mode, the ac/dc or ac/ac difference is always indicated on the control display in ppm, %, volts or ratio.

The 5790A is a fully autoranging instrument and selects the best voltage range for the measurement you are making. You may also select and lock in ranges manually. Robust 1200V input protection is active on all voltage ranges.

Using the trigger keys, the 5790A can switch from continuous to single measurements of the input voltage, making it easy to take sample readings at predetermined intervals.

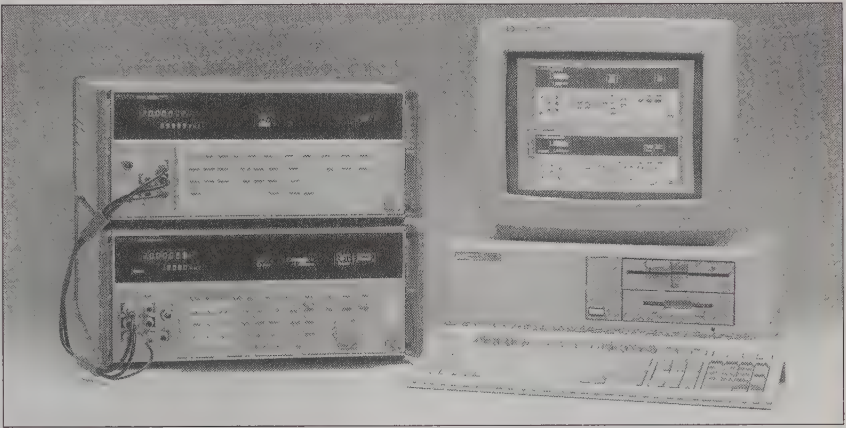
When using the 5790A in transfer mode, the reference voltage is stored automatically, and all ac/dc or ac/ac difference measurements are made relative to it. At any time, you can view the reference by pressing the VIEW REF key. You may also store the average of two voltages as a reference to eliminate dc reversal errors, for example.

The intuitive front panel layout of the 5790A makes manual operation fast and simple. Keys and selections are logically arranged and labelled. And messages and menus are displayed clearly on the 5790A's bright, vacuum fluorescent display.

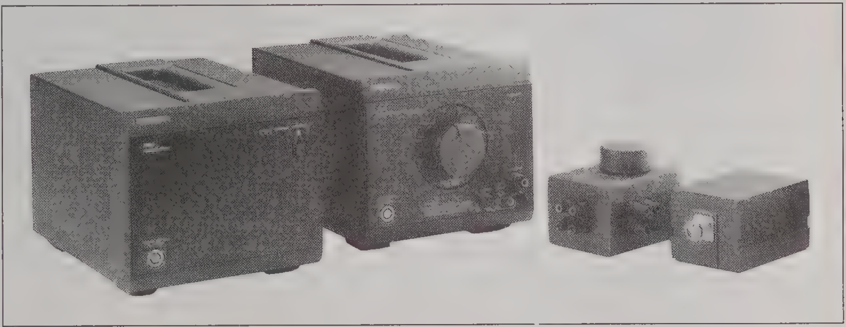
The 5790A is at home in automated systems as well. GPIB/IEEE-488* and RS-232C interfaces are included and all functions of the instruments can be controlled by a variety of host computers, including PCs. Using an available instrument driver, the 5790A can be integrated into automated systems operating under MET/CAL™ Calibration Software.

Designed With Your Support Requirements in Mind

The 5790A provides a self-contained calibration procedure designed to simplify periodic performance verification. The operator is prompted on what actions to take. To minimize the equipment required, the 5790A is designed to be supported by the Fluke 792A AC/DC Transfer Standard.



The 5790A is designed to meet the ac verification requirements of the Fluke 5700A Calibrator.



Traceability to national standards for the 5790A is supported through the Fluke 792A.

Specifications

Performance Specifications

To simplify evaluation of how the 5790A covers your calibration workload, use the Absolute Uncertainty Specifications.

Absolute Uncertainties include stability, temperature coefficient, linearity and traceability to external standards.

You do not need to add anything to determine the ratios between 5790A uncertainties and the uncertainties of your calibration workload when used within ±5°C of calibration temperature.

Maximum Non-Destructive Input: 200V rms
Wideband Guard Isolation: 0.5V peak
Wideband Input Impedance
1 kHz: 50Ω (±0.5%)
30 MHz: 50Ω (±5%)
Wideband VSWR with 50Ω Source
1 kHz: 1.005
30 MHz: 1.05

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Absolute Uncertainty Specifications (continued)

±5°C of Calibration Temperature

Voltage Range	Frequency Range	Absolute Uncertainty			
		AC/DC Transfer Mode	Measurement Mode		
		±PPM	±(PPM of Reading + μV)		
		2 Years	90 Days	1 Year	2 Years
2.2 mV	10 Hz - 20 Hz		1700 + 1.3	1700 + 1.3	1700 + 1.3
	20 Hz - 40 Hz		740 + 1.3	740 + 1.3	740 + 1.3
	40 Hz - 20 kHz		420 + 1.3	420 + 1.3	420 + 1.3
	20 kHz - 50 kHz		810 + 2.0	810 + 2.0	820 + 2.0
	50 kHz - 100 kHz		1200 + 2.5	1200 + 2.5	1200 + 2.5
	100 kHz - 300 kHz		2300 + 4.0	2300 + 4.0	2300 + 4.0
	300 kHz - 500 kHz		2400 + 6.0	2400 + 8.0	2600 + 8.0
	500 kHz - 1 MHz		3200 + 6.0	3500 + 8.0	5000 + 8.0
7 mV	10 Hz - 20 Hz		850 + 1.3	850 + 1.3	850 + 1.3
	20 Hz - 40 Hz		370 + 1.3	370 + 1.3	370 + 1.3
	40 Hz - 20 kHz		210 + 1.3	210 + 1.3	210 + 1.3
	20 kHz - 50 kHz		400 + 2.0	400 + 2.0	410 + 2.0
	50 kHz - 100 kHz		600 + 2.5	600 + 2.5	610 + 2.5
	100 kHz - 300 kHz		1200 + 4.0	1200 + 4.0	1200 + 4.0
	300 kHz - 500 kHz		1300 + 6.0	1300 + 8.0	1400 + 8.0
	500 kHz - 1 MHz		2000 + 6.0	2300 + 8.0	3600 + 8.0
22 mV	10 Hz - 20 Hz		290 + 1.3	290 + 1.3	290 + 1.3
	20 Hz - 40 Hz		180 + 1.3	190 + 1.3	190 + 1.3
	40 Hz - 20 kHz		110 + 1.3	110 + 1.3	110 + 1.3
	20 kHz - 50 kHz		210 + 2.0	210 + 2.0	210 + 2.0
	50 kHz - 100 kHz		310 + 2.5	310 + 2.5	310 + 2.5
	100 kHz - 300 kHz		810 + 4.0	810 + 4.0	820 + 4.0
	300 kHz - 500 kHz		860 + 6.0	890 + 8.0	1000 + 8.0
	500 kHz - 1 MHz		1400 + 6.0	1700 + 8.0	2600 + 8.0
70 mV	10 Hz - 20 Hz		240 + 1.5	240 + 1.5	240 + 1.5
	20 Hz - 40 Hz		120 + 1.5	120 + 1.5	130 + 1.5
	40 Hz - 20 kHz		64 + 1.5	65 + 1.5	69 + 1.5
	20 kHz - 50 kHz		120 + 2.0	130 + 2.0	130 + 2.0
	50 kHz - 100 kHz		260 + 2.5	260 + 2.5	260 + 2.5
	100 kHz - 300 kHz		510 + 4.0	510 + 4.0	530 + 4.0
	300 kHz - 500 kHz		660 + 6.0	670 + 8.0	680 + 8.0
	500 kHz - 1 MHz		1100 + 6.0	1100 + 8.0	1300 + 8.0
220 mV	10 Hz - 20 Hz	210	210 + 1.5	210 + 1.5	210 + 1.5
	20 Hz - 40 Hz	82	84 + 1.5	85 + 1.5	87 + 1.5
	40 Hz - 20 kHz	34	37 + 1.5	38 + 1.5	43 + 1.5
	20 kHz - 50 kHz	67	69 + 2.0	69 + 2.0	73 + 2.0
	50 kHz - 100 kHz		160 + 2.5	160 + 2.5	160 + 2.5
	100 kHz - 300 kHz		240 + 4.0	250 + 4.0	280 + 4.0
	300 kHz - 500 kHz		360 + 6.0	380 + 8.0	400 + 8.0
	500 kHz - 1 MHz		940 + 6.0	1000 + 8.0	1200 + 8.0
700 mV	10 Hz - 20 Hz	210	210 + 1.5	210 + 1.5	210 + 1.5
	20 Hz - 40 Hz	73	75 + 1.5	76 + 1.5	78 + 1.5
	40 Hz - 20 kHz	27	31 + 1.5	33 + 1.5	38 + 1.5
	20 kHz - 50 kHz	47	50 + 2.0	51 + 2.0	56 + 2.0
	50 kHz - 100 kHz		79 + 2.5	79 + 2.5	84 + 2.5
	100 kHz - 300 kHz		160 + 4.0	180 + 4.0	210 + 4.0
	300 kHz - 500 kHz		300 + 6.0	300 + 8.0	340 + 8.0
	500 kHz - 1 MHz		900 + 6.0	960 + 8.0	1200 + 8.0

Voltage Range	Frequency Range	Absolute Uncertainty			
		AC/DC Transfer Mode	Measurement Mode		
		±PPM	±(PPM of Reading)		
		2 Years	90 Days	1 Year	2 Years
2.2V	10 Hz - 20 Hz	200	200	200	200
	20 Hz - 40 Hz	63	65	66	69
	40 Hz - 20 kHz	18	22	24	29
	20 kHz - 50 kHz	43	45	46	52
	50 kHz - 100 kHz		70	71	76
	100 kHz - 300 kHz		150	160	200
	300 kHz - 500 kHz		250	260	310
	500 kHz - 1 MHz		840	900	1200
7V	10 Hz - 20 Hz	200	200	200	200
	20 Hz - 40 Hz	63	66	67	70
	40 Hz - 20 kHz	18	22	24	29
	20 kHz - 50 kHz	44	46	48	53
	50 kHz - 100 kHz		80	81	88
	100 kHz - 300 kHz		180	190	220
	300 kHz - 500 kHz		380	400	470
	500 kHz - 1 MHz		1100	1200	1500
22V	10 Hz - 20 Hz	200	200	200	200
	20 Hz - 40 Hz	63	66	67	70
	40 Hz - 20 kHz	21	25	27	31
	20 kHz - 50 kHz	44	46	48	53
	50 kHz - 100 kHz		80	81	85
	100 kHz - 300 kHz		180	190	220
	300 kHz - 500 kHz		380	400	470
	500 kHz - 1 MHz		1100	1200	1500
70V	10 Hz - 20 Hz	200	200	200	200
	20 Hz - 40 Hz	63	67	68	72
	40 Hz - 20 kHz	25	30	32	39
	20 kHz - 50 kHz	55	56	57	63
	50 kHz - 100 kHz		91	94	110
	100 kHz - 300 kHz		190	200	220
	300 kHz - 500 kHz		400	410	510
	500 kHz - 1 MHz		1100	1200	1500
220V	10 Hz - 20 Hz	200	200	200	200
	20 Hz - 40 Hz	63	67	68	72
	40 Hz - 20 kHz	23	29	31	38
	20 kHz - 50 kHz	63	67	69	77
	50 kHz - 100 kHz		96	98	110
	100 kHz - 300 kHz		210	210	260
	300 kHz - 500 kHz		440	500	700
700V	10 Hz - 20 Hz	200	200	200	200
	20 Hz - 40 Hz	92	96	99	110
	40 Hz - 20 kHz	36	39	41	47
	20 kHz - 50 kHz		120	130	150
	50 kHz - 100 kHz		400	500	850
1000V	10 Hz - 20 Hz	200	200	200	200
	20 Hz - 40 Hz	92	96	99	110
	40 Hz - 20 kHz	33	37	38	44
	20 kHz - 50 kHz		120	130	150

Wideband Uncertainty Specifications (Option -03)

Voltage[1] Range	Frequency Range	Flatness[2] 1 Year ±3°C ±(% of Rdng + µV)	Flatness[3] Temperature Coefficient PPM/°C	Absolute Uncertainty 0°C to 50°C[4] ±(% of Reading + µV)			Resolution
				90 Days	1 Year	2 Years	
2.2 mV	10 Hz - 30 Hz	0.10 + 0	75	0.5 + 1.2	0.6 + 1.5	0.8 + 2	0.1 µV
	30 Hz - 120 Hz	0.05 + 0	75	0.5 + 1.2	0.6 + 1.5	0.8 + 2	
	120 Hz - 1.2 kHz	0.05 + 0	75	0.5 + 1.2	0.6 + 1.5	0.8 + 2	
	1.2 kHz - 120 kHz	0.05 + 0	75	0.5 + 1.2	0.6 + 1.5	0.8 + 2	
	120 kHz - 500 kHz	0.07 + 1	75	0.5 + 1.2	0.6 + 1.5	0.8 + 2	
	500 kHz - 1.2 MHz	0.07 + 1	75				
	1.2 MHz - 2 MHz	0.07 + 1	100				
	2 MHz - 10 MHz	0.17 + 1	200				
	10 MHz - 20 MHz	0.30 + 1	200				
	20 MHz - 30 MHz	0.70 + 2	400				
7 mV	10 Hz - 30 Hz	0.10 + 0	75	0.4 + 5	0.5 + 7	0.7 + 8	0.1 µV
	30 Hz - 120 Hz	0.05 + 0	75	0.4 + 5	0.5 + 7	0.7 + 8	
	120 Hz - 1.2 kHz	0.05 + 0	75	0.4 + 5	0.5 + 7	0.7 + 8	
	1.2 kHz - 120 kHz	0.05 + 0	75	0.4 + 5	0.5 + 7	0.7 + 8	
	120 kHz - 500 kHz	0.07 + 1	75	0.4 + 5	0.5 + 7	0.7 + 8	
	500 kHz - 1.2 MHz	0.07 + 1	75				
	1.2 MHz - 2 MHz	0.07 + 1	100				
	2 MHz - 10 MHz	0.1 + 1	200				
	10 MHz - 20 MHz	0.17 + 1	200				
	20 MHz - 30 MHz	0.37 + 1	300				
		±(% of Reading)					
22 mV	10 Hz - 30 Hz	0.10	75	0.4 + 10	0.5 + 13	0.7 + 16	0.1 µV
	30 Hz - 120 Hz	0.05	75	0.4 + 10	0.5 + 13	0.7 + 16	
	120 Hz - 1.2 kHz	0.05	75	0.4 + 10	0.5 + 13	0.7 + 16	
	1.2 kHz - 120 kHz	0.05	75	0.4 + 10	0.5 + 13	0.7 + 16	
	120 kHz - 500 kHz	0.07	75	0.4 + 10	0.5 + 13	0.7 + 16	
	500 kHz - 1.2 MHz	0.07	75				
	1.2 MHz - 2 MHz	0.07	75				
	2 MHz - 10 MHz	0.1	100				
	10 MHz - 20 MHz	0.17	100				
	20 MHz - 30 MHz	0.37	200				
70 mV	10 Hz - 30 Hz	0.10	40	0.4 + 20	0.5 + 30	0.6 + 40	1.0 µV
	30 Hz - 120 Hz	0.05	40	0.4 + 20	0.5 + 30	0.6 + 40	
	120 Hz - 1.2 kHz	0.05	40	0.4 + 20	0.5 + 30	0.6 + 40	
	1.2 kHz - 120 kHz	0.05	40	0.4 + 20	0.5 + 30	0.6 + 40	
	120 kHz - 500 kHz	0.05	40	0.4 + 20	0.5 + 30	0.6 + 40	
	500 kHz - 1.2 MHz	0.05	40				
	1.2 MHz - 2 MHz	0.05	75				
	2 MHz - 10 MHz	0.1	100				
	10 MHz - 20 MHz	0.15	100				
	20 MHz - 30 MHz	0.35	200				
220 mV	10 Hz - 30 Hz	0.10	40	0.3 + 60	0.4 + 80	0.5 + 100	1.0 µV
	30 Hz - 120 Hz	0.04	40	0.3 + 60	0.4 + 80	0.5 + 100	
	120 Hz - 1.2 kHz	0.04	40	0.3 + 60	0.4 + 80	0.5 + 100	
	1.2 kHz - 120 kHz	0.04	40	0.3 + 60	0.4 + 80	0.5 + 100	
	120 kHz - 500 kHz	0.04	40	0.3 + 60	0.4 + 80	0.5 + 100	
	500 kHz - 1.2 MHz	0.05	40				
	1.2 MHz - 2 MHz	0.05	75				
	2 MHz - 10 MHz	0.1	100				
	10 MHz - 20 MHz	0.15	100				
	20 MHz - 30 MHz	0.35	200				

[1] Range limits same as INPUT1 or INPUT2.

[2] Relative - 1 kHz.

[3] Add to flatness specifications when more than 3°C from calibration temperature.

[4] At input connector.

Shunt Input Characteristics

The shunt input was designed to allow ac/dc current transfers using the Fluke A40 Series Current Shunts. 5790A-7001 A40/A40A Current Shunt Adapter and cable required.

Shunt Model	Current Range
A40	2.5 mA-5A
A40A	5A-20A

Input Resistance: 91Ω ±1%
Operating Input Voltage: 250 mV to 500 mV
Maximum Non-Destructive Input: 50V rms

The 5790A is compatible with Fluke A40 and A40A Current Shunts to permit measurements to 20A.

General Specifications

Warm-up Time: 30 minutes

Relative Humidity
Operating: 45% to 50°C; 75% to 45°C; 95% to 30°C
Storage: <95% non-condensing

Altitude
Operating: 3,050 meters (10,000 feet)
Non-Operating: 12,200 meters (40,000 feet)

Temperature
Operating: 0°C to 50°C
Calibration: 15°C to 35°C
Storage: -40°C to 70°C
EMI/RFI: Complies with FCC Part 15 Subpart B, Class B; VDE 0871, Class B; ESD: EIA PN-1361. Surge: ANSI C62.41-1980, Category A
Reliability: MIL-T-28800D, paragraph 3.13.3
Line Power: 47 Hz to 63 Hz; ±10% of selectable line voltages: 100V, 110V, 115V, 120V, 200V, 220V, 230V, 240V
Safety: Complies with UL1244 and IEC348-1978 and IEC 1010 and CSA C22.2 No. 231
Remote Interfaces: RS-232C, IEEE-488

Size
Height: 17.8 cm (7 in) standard rack mount + 1.5 cm (0.6 in)
Width: 43.2 cm (17 in)
Depth: 63 cm (24.8 in)
Maximum Power: 5790A: 95 VA; with wideband: 120 VA
Weight: 5790A: 24 kg (53 lb); with wideband: 24.5 kg (54 lb)

Wideband Uncertainty Specifications (Option -03) (continued)

Voltage[1] Range	Frequency Range	Flatness[2] 1 Year ±3°C ±(% of Rdng + µV)	Flatness[3] Temperature Coefficient PPM/°C	Absolute Uncertainty 0°C to 50°C[4] ±(% of Reading + µV)			Resolution
				90 Days	1 Year	2 Years	
700 mV	10 Hz - 30 Hz	0.10	40	0.3 + 200	0.4 + 300	0.5 + 400	10.0 µV
	30 Hz - 120 Hz	0.03	40	0.3 + 200	0.4 + 300	0.5 + 400	
	120 Hz - 1.2 kHz	0.03	40	0.3 + 200	0.4 + 300	0.5 + 400	
	1.2 kHz - 120 kHz	0.03	40	0.3 + 200	0.4 + 300	0.5 + 400	
	120 kHz - 500 kHz	0.03	40	0.3 + 200	0.4 + 300	0.5 + 400	
	500 kHz - 1.2 MHz	0.05	40				
	1.2 MHz - 2 MHz	0.05	75				
	2 MHz - 10 MHz	0.1	100				
	10 MHz - 20 MHz	0.15	100				
	20 MHz - 30 MHz	0.35	200				
2.2V	10 Hz - 30 Hz	0.10	40	0.3 + 300	0.35 + 400	0.4 + 500	10.0 µV
	30 Hz - 120 Hz	0.03	40	0.3 + 300	0.35 + 400	0.4 + 500	
	120 Hz - 1.2 kHz	0.03	40	0.3 + 300	0.35 + 400	0.4 + 500	
	1.2 kHz - 120 kHz	0.03	40	0.3 + 300	0.35 + 400	0.4 + 500	
	120 kHz - 500 kHz	0.03	40	0.3 + 300	0.35 + 400	0.4 + 500	
	500 kHz - 1.2 MHz	0.05	40				
	1.2 MHz - 2 MHz	0.05	75				
	2 MHz - 10 MHz	0.1	100				
	10 MHz - 20 MHz	0.15	100				
	20 MHz - 30 MHz	0.35	200				
7V	10 Hz - 30 Hz	0.10	40	0.3 + 500	0.35 + 800	0.4 + 1000	100.0 µV
	30 Hz - 120 Hz	0.03	40	0.3 + 500	0.35 + 800	0.4 + 1000	
	120 Hz - 1.2 kHz	0.03	40	0.3 + 500	0.35 + 800	0.4 + 1000	
	1.2 kHz - 120 kHz	0.03	40	0.3 + 500	0.35 + 800	0.4 + 1000	
	120 kHz - 500 kHz	0.03	40	0.3 + 500	0.35 + 800	0.4 + 1000	
	500 kHz - 1.2 MHz	0.05	40				
	1.2 MHz - 2 MHz	0.05	75				
	2 MHz - 10 MHz	0.01	100				
	10 MHz - 20 MHz	0.15	100				
	20 MHz - 30 MHz	0.35	200				

[1] *Range limits same as INPUT1 or INPUT2.*

[2] *Relative - 1 kHz.*

[3] *Add to flatness specifications when more than 3°C from calibration temperature.*

[4] *At input connector.*

Ordering Information

Model

5790A AC Measurement Standard

Option

5790A-03 Wideband AC Measurement

Accessories (Also see Section 19)

5440A-7002 Low Thermal Cable Set

792A-7003 Transfer Switch

792A-7004 A40 Current Shunt Adapter. Connects directly to Type-N input connector to permit use with A40 Current Shunts. Not compatible with A40A Current Shunts.

5790A-7001 A40/A40A Current Shunt Adapter and Cable. Connects to current shunt binding posts to permit use with both A40 and A40A Current Shunts.

A40 Current Shunts (10, 20, 50, 100, 200, 300, 500 mA and 1, 2, 3, 5A). Requires 792A-7004 or 5790A-7001.

A40A Current Shunts (10 and 20A). Requires 5790A-7001.

Y5737 5790A Rack Mount Kit. Includes 24" slides that allow for side ventilation.

Y8021 Shielded IEEE-488 Cable, 1m

Y8022 Shielded IEEE-488 Cable, 2m

Y8023 Shielded IEEE-488 Cable, 4m

Manuals

5790A Operator*

5790A Remote Programming Reference Guide

5790A Service

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty

One-year product warranty.

734A

734A Reference Standard

- Four independent 10V and 1.018V outputs
- 0.3 ppm stability per month, 2 ppm per year stability
- 15°C to 35°C operation • Short circuit proof
- Traceable calibration to NIST, and the Fluke 10V Josephson Array
- Line and rechargeable battery powered • 72-hr battery life for calibration transfer

The model 734A DC Reference Standard is a four-cell direct voltage reference used to maintain the volt in primary and secondary calibration laboratories. Four truly independent cells allow statistical methods to be used to reduce the uncertainty of the 734A outputs to levels previously obtained by only the most sophisticated standards laboratories. Since each 732B is independent and battery operated, it can easily be slipped out of the 734A enclosure and used as a highly stable, portable dc voltage transfer standard. A single 734A functions both as a laboratory primary standard and as a portable transfer standard. The light weight (13 lbs) and 70 hours of battery life of the individual cells also simplify and reduce the costs for long-distance transfer procedures. Therefore, a single 734A functions both as a laboratory primary standard and as a source for portable transfer standards.

The long-term stability, predictable drift rate, and low uncertainty of the 734A 10V output allows direct substitution for saturated standard cells in many applications. With time characterization (calibration option 732B-100) the drift rate uncertainty for each 10V output is no more than ±1 ppm per year. This level of uncertainty is achieved by enclosing propriety Fluke reference components in a precision, temperature-controlled oven.

Technical Specifications

Absolute Uncertainty: The 734A and 732B are normally delivered without absolute uncertainty specifications because, to maintain traceability they must continue to receive uninterrupted operating voltage from the ac power lines or from the internal batteries. The 734A is normally shipped from the factory with the battery switches turned off. Upon receipt, the 734A must be powered up and allowed to stabilize for 24 hours before calibration against traceable standards. The absolute uncertainty specification for the standards must be related to the uncertainty specifications for the traceable standards used for calibration. For certified calibrations order options -000 or -100, described under the DVMP in this catalog.

Stability: Parts per million, (23 ±1°C)

Output	30 Days	1 Year
10V	±0.3	±2.0
1.018V	±0.4	

Temperature Coefficient: ≤ ±0.04 ppm per °C for 10V output, ≤ ±0.1 ppm per °C for 1.018V output, from 15°C to 35°C

Output Adjustment: ±2 mV for 10V output, none on the 1.018V output

Output Impedance: 1 mΩ for 10V output, 1 kΩ for 1.018V output

Output Current: Up to 12 mA for 10V output, limited by 1 kΩ output impedance for 1.018V output

Output Protection: May be shorted indefinitely, protected against high voltage input transients to 1100V

Load Regulation: ≤0.1 ppm for a load change in the range 0 to 2 mA, ≤1 ppm for a load change in the range 2 to 12 mA for the 10V output

Line Regulation: ≤0.05 ppm of output for a ±10% line change

General Specifications

Temperature: 15°C to 35°C, operating; -51°C to 71°C, non-operating (with internal battery pack switched off)

Relative Humidity: ≤95% to 30°C, ≤75% to 35°C, non-condensing

Altitude: ≤3049m (10,000 ft) operating, ≤12,195m (40,000 ft) non-operating

Vibration: Per MIL-T-28800; Type III, Class 5, Style E

Safety: Designed to IEC 348, 2nd edition; 1978 and ANSI/ISA-S82; and UL1244, 2nd edition 1980, CSA C22.2 No 231, and IEC 1010

734A DC Reference Standard

Size: 17.8 cm H x 43.2 cm W x 43.6 cm D (7 in H x 17 in W x 19.8 in D) (with handles)

Weight: 29 kg (65 lb)

732B DC Standard

Power: 100V, 120V, 220V, 240V ac ±10%; 50 Hz to 60 Hz; 66W max. Internal 12V lead acid, gelled electrolyte battery operates for 70 hours at 23°C when fully charged. Trickle-charged continually when external ac power is applied.

Size: 13.1 cm H x 9.6 cm W x 40.6 cm D (5.16 in H x 3.78 in W x 15.98 in D)

Weight: 5.91 kg (13 lb)

732B-7001 External Battery and Charger

Power: 100V, 120V, 220V, 240V ac ±10%; 50 Hz to 60 Hz; 66W max. Internal 12V lead acid, gelled electrolyte battery operates for 70 hours at 23°C when fully charged. Trickle-charged continually when external ac power is applied.

Size: 13.1 cm H x 9.6 cm W x 40.6 cm D (5.16 in H x 3.78 in W x 15.98 in D)

Weight: 5.45 kg (12 lb)

Ordering Information

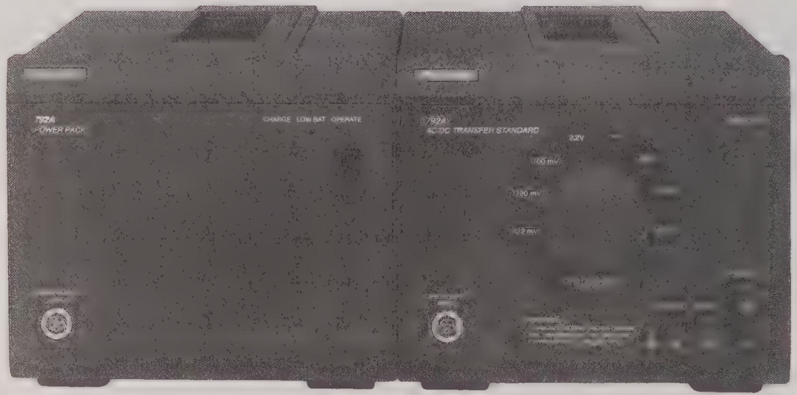
Models

734A DC Reference Standard
732B DC Standard
732B-000 Special Calibration, shipped hot*
732B-000I 10V Output Voltage Calibration for one 732B for international shipment
732B-100 Special Calibration and Drift Characterization, shipped hot*
732B-100I 10V Output Voltage Calibration and Drift Rate Characterization for one 732B for international shipment
732B-200 On-Site Calibration w/Fluke owned standard
732B-201 Calibration of additional standards, on-site

**Under power*

Accessories (Also see Section 19)
732B-7001 External Battery and Charger
732B-7002 Transit Case (1 or 2 732Bs)
734A-7001 Instrument Enclosure
5440A-7002 Low Thermal EMF Copper Plug-in Cables
Y734 Rack Mount Kit

792A



792A

792A AC/DC Transfer Standard
10 ppm total uncertainty
Traceable to national standards
Voltage range 2 mV to 1000V
Frequency range 10 Hz to 1 MHz
Fast and easy to use

Support For Your Most Demanding AC Measurement Requirements

The Fluke 792A is an ultra-high accuracy AC/DC Thermal Transfer Standard designed to meet the most demanding ac measurement requirements. Using the patented Fluke RMS sensor and thin film range resistors, the 792A offers an extraordinary transfer accuracy, with total uncertainties of as low as ±10 ppm (±5 ppm from the U.S. National Institute of Standards and Technology (NIST)). The 792A also provides a wide voltage range of 2 mV to 1000V, and wide frequency range of 10 Hz to 1 MHz.

The Fluke solid-state rms sensor also provides the 792A with remarkable temperature stability and fast settling time. Now you can be ready to make measurements in 30 seconds instead of 30 minutes. To simplify the transfer process, the 792A's 2V output permits you to use a high resolution digital multimeter rather than a null meter.

The Fluke 792A is designed to support the calibration of the most accurate ac instruments in your standards lab workload, including calibrators like the Fluke 5700A, voltmeters like the Fluke 8506A, voltage amplifiers and other ac/dc transfer standards.

Accurate, Fast and Easy To Use

At the heart of the Fluke 792A is the patented Fluke Solid-State Thermal RMS Sensor, which has been proven in a variety of Fluke products since 1979. Its output voltage is 2V, compared to the 7 to 10 mV output of traditional thermocouples. That means the 792A exhibits excellent signal-to-noise characteristics and minimal reversal errors, as low as 10 ppm relative to input voltage. The 2V output also permits you to make measurements with high resolution, so you can use digital voltmeter rather than a null meter to make transfers. Not only are measurements easier to make, they are more precise as well. And because it is small, the rms sensor has very low thermal mass, so the 792A stabilizes in as little as 30 seconds and can be used under a wide temperature range of 11°C and 35°C.

The rms sensor is designed to be rugged and reliable. Each is built to exacting standards by the Fluke Microelectronics Laboratory to maintain quality and consistency, part after part.

Fully Traceable Performance

Each 792A is shipped from Fluke with documented traceability to the NIST. Included is a table of correction factors and uncertainties for measured ac/dc differences.

To support the traceability requirements for an instrument as accurate as the 792A, the Fluke Metrology Department developed a unique system to transfer NIST values to the 792A production environment. This system is based on proven techniques developed to maintain a 732B direct voltage standard to within a few parts in 100 billion. Statistical treatment of data resulting from successive intercomparisons of virtually identical 792As is used to minimize transfer uncertainties. To achieve even higher performance, you can have the transfer uncertainties of your 792A assigned directly by NIST or other national standards organizations. For more information, request our application note titled Establishing Traceability for the 792A, document number B0205.

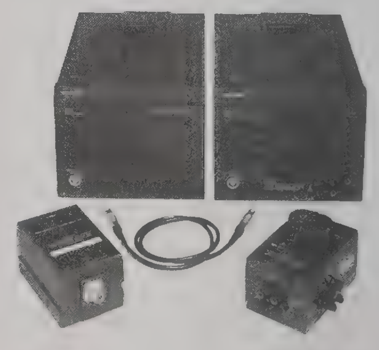
Periodic calibration and recertification is available from Fluke. This service repeats the original calibration procedure. A new table of correction factors and uncertainties for measured ac/dc differences is returned with your instrument. Order 792A-000.

Description

The 792A consists of four units.

The Transfer Unit is the main analog component of the 792A for the 20 mV to 220V ranges. Stainless Steel Type-N connectors assure low signal loss and high measurement repeatability. The separate Power Pack unit permits the Transfer Unit and 1000V Range Resistor to be shipped independently for calibration. The 1000V Range Resistor isolates the heat generated at high voltages outside the main Transfer Unit. The Range Resistor has a low temperature coefficient, stabilizes quickly and exhibits small ac/dc differences. The Transfer Switch provides for switching between the ac and dc inputs.

Each 792A is shipped from the factory traceable to NIST standards. Each 792A also includes a table of correction factors and uncertainties for measured ac/dc differences.



Specifications

The following tables of uncertainties are absolute and traceable to national standards. Absolute uncertainty includes time stability, temperature coefficient, line and load regulation, and the traceability of external standards. These uncertainties apply when the calibration report, provided with the 792A, is utilized to correct the response of the transfer standard.

Corrected Absolute AC/DC Uncertainty: 1 year, T_{CAL} ±5°C

AC/DC Uncertainty ± ppm Input														
Voltage		Frequency (Hz)												
Voltage Range	Voltage Input	10 Hz	20 Hz	40 Hz	100 Hz	1 kHz	10 kHz	20 kHz	50 kHz	100 kHz	300 kHz	500 kHz	800 kHz	1 MHz
22 mV	2 mV	2200	1600	1600	1600	1600	1600	1600	1600	1900	2500	4500	5000	5000
	6 mV	500	400	350	350	350	350	350	500	1000	1500	1800	1800	1800
	10 mV	320	280	280	280	280	280	280	300	500	700	1200	1500	1500
	20 mV	280	180	140	125	125	125	125	200	450	650	1000	1000	1000
220 mV	20 mV	350	230	190	190	190	190	190	220	450	650	1000	1100	1100
	60 mV	230	120	80	60	60	60	60	120	250	500	600	600	600
	100 mV	210	90	50	50	50	50	50	65	150	270	300	350	350
	200 mV	200	80	40	30	30	30	30	65	150	220	250	300	300
700 mV	200 mV	220	80	50	50	50	50	50	75	150	220	250	300	300
	600 mV	200	70	30	22	22	22	22	45	60	130	140	140	140
2.2V	600 mV	200	65	30	25	25	25	25	45	60	120	140	140	140
	1V	190	60	30	15	15	15	15	40	50	115	125	125	125
	2V	190	60	25	10	10	10	10	40	50	115	125	125	125
7V	2V	190	65	30	22	22	22	22	45	55	120	140	140	140
	6V	190	60	25	10	10	10	10	40	50	120	125	125	125
22V	6V	190	65	30	22	22	22	22	45	55	120	125	140	140
	10V	190	60	30	15	15	15	15	40	50	120	125	125	125
	20V	190	60	25	15	15	15	15	40	50	120	125	125	125
70V	20V	190	65	30	25	25	25	25	55	70	130	140	140	140
	60V	190	60	25	20	20	20	20	50	65	130			
220V	60V	190	65	33	33	33	33	33	65	70	130			
	100V	190	65	30	20	20	20	20	60	70	130			
	200V	190	60	27	18	18	18	18	60	70	130			
1000V	200V	190	90	40	33	33	33	33	65	70				
	600V	190	90	35	27	27	30	30	60	70				
	1000V	190	90	27	25	25	27	27	60	70				

Volt-Hertz Product: 1x10^8 @ 100 kHz, 2.2x10^7 @ 1 MHz
Waveform Requirements: Sinusoidal, distortion less than 1%

Settling Time

Voltage Range	Settling Time
22 mV	60 sec
220 mV	60 sec
700 mV	60 sec
2.2V	30 sec
7V	30 sec
22V	30 sec
70V	30 sec
220V	30 sec
1000V	30 sec

For amplitude changes of less than 10%, settling times are typically 20% of those indicated in the table above

Output Characteristics

Impedance: <30 MΩ
Current: Up to 20 mA drive capability

Protection: Protected against damage due to high voltage up to 200V, provided the peak current does not exceed 50 mA. May be shorted indefinitely without damage to the instrument.

Tolerance: The output voltage is approximately 2V at full scale of any range with following tolerances:

Voltage Range	Tolerance
22 mV	5% + 5.3 mV
220 mV	5% + 760 µV
700 mV	5% + 500 µV
2.2V	10% + 300 µV
7V	10% + 300 µV
22V	10% + 300 µV
70V	10% + 300 µV
220V	10% + 300 µV
1000V	10% + 300 µV

Battery Characteristics

The following characteristics are typical and apply at 23°C. Four, 6V lead-acid, sealed, gelled-electrolyte batteries are used.

Battery Life: 22 mV to 700 mV ranges, 24 hours; 2.2V to 1000V ranges, 72 hours
Battery Charge Time: 16 hours to full charge
Low Battery Life: 22 mV to 700 mV ranges, 30 minutes; 2.2V to 1000V ranges, 60 minutes

DC Reversal Error

The following table of errors is relative to the input voltage and applies over each entire range

Voltage Range	Input Voltage	Maximum Reversal Error
22 mV	2.2-22 mV	90 µV
220 mV	22-220 mV	90 µV
700 mV	220-700 mV	90 µV
2.2V	0.7-2.2V	10 ppm
7V	2.2-7V	10 ppm
22V	7-22V	10 ppm
70V	22-70V	10 ppm
220V	70-220V	10 ppm
1000V	220-1000V	10 ppm

Input Impedance

Voltage Range	Input Impedance	
	Resistance	Shunt Capacitance
22 mV	10 MΩ	<40 pF
220 mV	10 MΩ	<40 pF
700 mV	10 MΩ	<40 pF
2.2V	420Ω	<20 pF
7V	1.2 kΩ	<20 pF
22V	4 kΩ	<20 pF
70V	12 kΩ	<20 pF
220V	40 kΩ	<20 pF
1000V	200.4 kΩ	<20 pF

Maximum Input Voltage

The following table lists both the maximum operational and the non-destructive rms voltages

Voltage Range	Maximum Input Voltage	
	Operational	Non-Destructive
22 mV	22 mV	3V
220 mV	220 mV	3V
700 mV	700 mV	3V
2.2V	2.2V	50V
7V	7V	50V
22V	22V	50V
70V	70V	130V
220V	220V	250V
1000V	1000V	1000V

General Specifications

Temperature Stabilization: Allow 12 hours stabilization time in the environment of use
Warm-Up Time: 15 minutes with power on, after stabilization time
Temperature Performance: Operating: 11°C to 35°C; calibration: 18°C to 28°C; storage: -40°C to 50°C

Relative Humidity: Operating: <75% to 30°C, <70% to 35°C; storage: <95%, non-condensing
Altitude: Operating: to 3,050m (10,000 ft); non-operating: to 12,200M (40,000 ft)
Safety: Designed to comply with UL 1244 (1987); IEC 348-1978; IEC 1010; CSA 556B and ANSI/ISA 582
Input Low Isolation: 20V to chassis
Guard Isolation: 10V to input LO or chassis
EMI/RFI: Designed to comply with FCC Rules Part 15, Subpart J, Class B; VDE 0871, Class B; VDE 0875, Class K
Reliability: MIL-STD-28800D, para 3.13.3
Line Power: 50 Hz to 60 Hz ±5% allowed about selectable nominal line voltages: 100V, 120V, 220V, 240V ±10%; maximum power: 45 VA

Size
Transfer Unit: 17.8 cm H x 21.6 cm W x 30.5 cm D (7 in H x 8.5 in W x 12 in D)
Power Pack: 17.8 cm H x 21.6 cm W x 30.5 cm D (7 in H x 8.5 in W x 12 in D)
1000V Range Resistor: 7.6 cm H x 8.9 cm W x 14.0 cm D (3 in H x 3.5 in W x 5.5 in D)
Transfer Switch: 7.6 cm H x 8.9 cm W x 14.0 cm D (3 in H x 3.5 in W x 5.5 in D)

Weight
Transfer Unit: 8.4 kg (18.5 lb)
Power Pack: 8.9 kg (19.5 lb)
1000V Range Resistor: 1.6 kg (3.5 lb)
Transfer Switch: 1.6 kg (3.5 lb)

Ordering Information

Model

792A AC/DC Transfer Standard

Included with Instrument

Transfer Unit, Power Pack, 1000V Range Resistor, Transfer Switch, Instruction manual and Certificate of Calibration Practices.

Accessories (Also see Section 19)
792A-7001 Power Pack
792A-7002 1000V Range Resistor
792A-7003 Transfer Switch
792A-7004 A40 Current Shunt Adapter

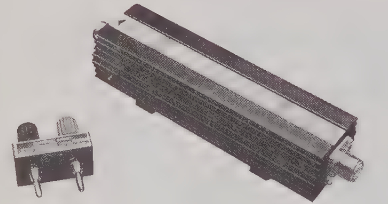
Manual
792 Instruction*

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.



A40/A40A

A40 and A40A Current Shunts

- AC current transfer measurements from 2.5 mA to 20A
- Frequency response from 5 Hz to 100 kHz

Models A40 and A40A Current Shunts make possible accurate ac to dc current transfer measurements using the Models 792A AC/DC Transfer Standard and a known dc source. Measurements may be made over a 2.5 mA to 20A range with a frequency response from 5 Hz to 50 kHz. Measurements to 100 kHz may be made up to 5A.

Twelve A40 Current Shunts are available with current ratings from 10 mA to 5A. A40A shunts are available with current ratings of 10A and 20A. Each shunt maintains specified accuracy down to half its rated current level.

A40A shunts require special cables, available separately.

Calibration

All ac to dc differences expressed in the specifications are deviations from dc standards maintained by the U.S. National Institute of Standards and Technology (NIST), and may be obtained without the used of calibration curves or correction tables. These ac to dc difference figures do not include NIST random and systematic errors. Fluke test reports to the nearest 100 ppm (0.01%) are available at extra cost upon request.

Specifications

A40 Current Ratings: 10, 20, 30, 50, 100, 200, 300, and 500 mA; 1, 2, 3, and 5A (rms)
A40A Current Ratings: 10A and 20A (rms)

C41 Storage Case for A40 Shunt

Uncertainty

Frequency	AC to DC Difference	
	A40	A40A
5 Hz - 20 kHz	±0.02%	±0.03%
20 kHz - 50 kHz	±0.03%	±0.05%
50 kHz - 100 kHz	±0.05%	

Ordering Information

Models

A40 Current Shunt
A40A Current Shunt

Accessories (Also see Section 19)
A45-4003 Input Cable for A40A Shunt
A45-4004 Output Cable for A40A Shunt
Y8133 Universal Test Lead Set
C41 Storage Case for A40 Shunt

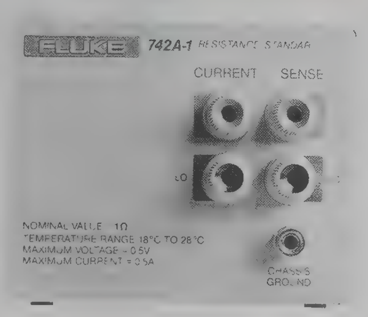
**Order by current rating, e.g.: A40-10 mA, A40A-10A*

Note: National Stock Numbers are available for most A40 and A40A Shunts. Contact your Fluke sales engineer for details.

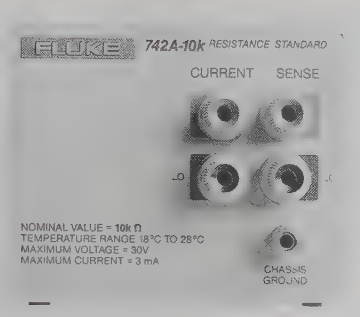
Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.


FLUKE
742A-1 RESISTANCE STANDARD
CURRENT
SENSE
LO
NOMINAL VALUE = 1Ω
TEMPERATURE RANGE 18°C TO 28°C
MAXIMUM VOLTAGE = 0.5V
MAXIMUM CURRENT = 0.5A
CHASSIS GROUND

742A-1


FLUKE
742A-10k RESISTANCE STANDARD
CURRENT
SENSE
LO
NOMINAL VALUE = 10k Ω
TEMPERATURE RANGE 18°C TO 28°C
MAXIMUM VOLTAGE = 30V
MAXIMUM CURRENT = 3 mA
CHASSIS GROUND

742A-10k

742A Resistance Standards

- Small and rugged
- No oil or air baths required
- 18°C to 28°C operating range
- Supplied with temperature characterization
- Six-month stability to 2.5 ppm

Fluke 742A Resistance Standards are high accuracy working standards for precision, on-site resistance calibration. Their excellent temperature stability allows them to be used from 18°C to 28°C with typically less than 2 ppm degradation. Using the calibration table supplied with the standards, which lists corrections in 0.5°C increments, this uncertainty can be reduced to near zero. No cumbersome oil or air baths are required.

Because 742A Resistance Standards are small and rugged, they are easy to transport. Care has been taken to reduce resistance changes brought about by thermal and mechanical shock. Retrace (permanent shift in resistance) is typically less than 2 ppm after cycling between 0°C and 40°C.

The 742A-1 1Ω and the 742A-10k 10 kΩ units are ideally suited for Artifact Calibration of the Fluke 5700A Calibrator. The other values can be used to verify the calibration if you desire.

A convenient transit case, designed to hold two standards, is available as an option.

Specifications

Model	Nominal Value ±2 ppm (Ohms)	Stability		Calibration Uncertainty 23°C (PPM)	Max Change 18-28°C (± PPM)	Max Voltage (Volts)
		6 Month (PPM)	12 Month (PPM)			
742A-1	1.0	5.0	8.0	1.0	3.0	0.5
742A-1.9	1.9	5.0	8.0	1.0	3.0	0.38
742A-10	10.0	5.0	8.0	1.0	3.0	1.0
742A-100	100.0	4.0	6.0	1.0	3.0	2.0
742A-1k	1.0k	4.0	6.0	1.5	2.0	10.0
742A-10k	10.0k	2.5	4.0	1.0	1.5	30.0
742A-19k	19.0k	2.5	4.0	1.5	2.0	28.5
742A-100k	100.0k	4.0	6.0	2.5	2.0	100.0
742A-1M	1.0M	6.0	8.0	5.0	2.0	100.0
742A-10M	10.0M	6.0	9.0	10.0	3.0	200.0
742A-19M	19.0M	8.0	10.0	20.0	4.0	190.0

Operating Temperature Range: 18-28°C
Storage Temperature: 0-40°C
Retrace Error (hysteresis):
23°C-18°C-23°C cycle: Negligible resistance shift
23°C-28°C-23°C cycle: Negligible resistance shift
23°C-0°C-23°C cycle: <2 ppm resistance shift
23°C-40°C-23°C cycle: <2 ppm resistance shift
Size: 8.6 cm H x 10.5 cm W x 12.7 cm D (3.4 in H x 4.15 in W x 5 in D)
Weight: .68 kg to .91 kg (1.5 lb to 2 lb) depending on the model

Ordering Information

Models

742A-1 1Ω Resistance Standard
742A-1.9 1.9Ω Resistance Standard
742A-10 10Ω Resistance Standard
742A-100 100Ω Resistance Standard
742A-1k 1 kΩ Resistance Standard
742A-10k 10 kΩ Resistance Standard
742A-19k 19 kΩ Resistance Standard
742A-100k 100 kΩ Resistance Standard
742A-1M 1 MΩ Resistance Standard
742A-10M 10 MΩ Resistance Standard
742A-19M 19 MΩ Resistance Standard
742A-7002 Transit Case (holds 2 units)

Manual
742A Instruction*

No charge with purchase of unit

Optional 742A-7002 transit case.

Direct Voltage Maintenance Program

Direct Voltage Maintenance Program

- Volt traceability for your calibration laboratory with significant cost reductions over direct NIST calibration
- Uncertainty within a few tenths of a ppm
- Complies with MIL-STD-45662A
- Avoid investing in redundant hardware: equipment never needs to leave laboratory
- No possibility of accidental loading and destruction as with saturated standard cells

Built around the 732A/B Direct Voltage Reference Standard, the Fluke Direct Voltage Maintenance Program (DVMP) provides state-of-the-art uncertainty for your own laboratory, traceable to the Fluke Josephson Array and the U.S. National Institute of Standards and Technology (NIST). The 732A/B is a solid-state direct vol-tage reference standard that enables voltage transfers with uncertainties of only a few tenths of a ppm, while meeting the requirements for ruggedness and a range of operating temperatures. This level of performance is made possible by the low, predictable drift rate, allowing accurate extrapolation of the output voltage to be made over long time intervals. With the DVMP, traceability to the Fluke Josephson Array Voltage Standard can be achieved at the 0.1 ppm level. The DVMP also provides traceability to the U.S. legal volt with an uncertainty of 0.4 ppm.

Traceability

Traceability of your 10V standard is the principle objective of the DVMP. The Fluke Primary Standards Laboratory in Everett, Washington (U.S.A.) operates a 10V Josephson Array Voltage Standard and maintains traceability to NIST at the 10 volt level.

Four Services to Choose From

The Fluke Direct Voltage Maintenance Program consists of four calibration services, which can be used separately or in combination, depending on your needs. Two of the services are calibrations, performed completely by Fluke personnel. These calibrations are ordered as an option on new 732Bs. The other two calibration services are performed by the user, using Fluke-owned standards, at the user's site, with the data transmitted to the Fluke Standards Lab for reduction and analysis. Complete description of the options follows:

1. **Option 732B-000.** Order this option to have an output voltage calibration performed on a newly ordered 732B. Before shipment, your new 732B will be compared to the direct voltage standards maintained by the Fluke Primary Standards Laboratory. A report of calibration, listing the deviation from nominal and the uncertainty of calibration is delivered with the instrument. The instrument will be delivered under power from self-contained and auxiliary batteries to insure the calibration. Customers outside the U.S. and Canada should order 732B-000I which provides for shipment of the 732B under power up to six days.
2. **Option 732B-100.** Order this option to have a new instrument calibrated for output voltage and characterized for drift rate before shipment from the factory. Your new 732B will be tested for both output voltage and drift rate by comparison against traceable standards for a period of 60 days. Knowing the drift rate, the total uncertainty as a function of time is much reduced. A report of calibration, listing output voltage, drift rate, and uncertainties is delivered with the instrument which is shipped under power. Customers outside the U.S. and Canada should order 732B-100I which provides for shipment of the 732B under power up to six days.
3. **Option 732A-200.** This is the option to order for calibration of your 732A or 732B in your own laboratory. Fluke-owned and calibrated standards, together with all necessary connecting cables and clear operating instructions, will be sent to your site for comparison with your reference standard. A series of readings you make over a period of five days is recorded and returned to Fluke for evaluation at the Fluke Primary Standards Laboratory. A value is then assigned to your 10 volt standard, and a report of calibration is returned to you. After three calibrations without adjustment or repair of your 732A/B, information that allows you to predict output voltages up to one year after calibration with reduced uncertainty is reported. The quoted price for the 732A-200 option includes the shipping costs for the Fluke-owned standards. This service is guaranteed. In the event the transfer standards lose power, the calibration will be repeated at no cost to you.
4. **Option 732B-201.** If you have more than one 732A or 732B in your lab, order this option for calibration of each additional reference at the same site (must be ordered with Option 732B-200). Data collected and reports are the same as described for the 732B-200. For calibration of a 734A, order one 732A-200 and three 732A-201s.

Specifications

Option Number	Calibration Uncertainty (CU)*	Drift Rate Uncertainty (DU)**			Total Uncertainty
		30 Days	90 Days	1 Year	
732B-000	0.6 ppm	0.5 ppm	1.0 ppm	3.0 ppm	$\sqrt{[(CU)^{2} + (DU)^{2}]}$
732B-100	0.5 ppm	0.35 ppm	0.5 ppm	1.0 ppm	
732A-200	0.1 ppm***	**	**	**	

* *Typical 99% confidence level; actual uncertainties determined at the time of test*

** *Drift rate uncertainty will be established with repeated participation in the DVMP*

*** *<0.4 ppm traceable to NIST*

How To Order

It is important to recognize that proper timing and coordination of the activities between Fluke and your firm are essential to successful delivery of a 732B under power. Following receipt of an order for one of the DVMP services, you will be contacted directly by Fluke factory personnel. For this reason the following information must be included with each order:

- The option number ordered.
- **The exact address where the shipment will be received.**
- **The name and telephone number of the person who will be responsible for receiving the shipment and connecting it to the power line when it arrives.**
- The name and telephone number of an alternate responsible person if the first designated individual is unavailable.
- Any restrictions on hours of the day during which receiving can take place.
- Fluke guarantees arrival of the instrument under power. If it is delayed, Fluke or the carrier will pay the shipping charges for return of the instrument to Fluke for recalibration.

Ordering Information

Models

732B-000	10V Output Calibration of one new 732B
732B-000I	Same as 732B-000 for international shipment
732B-100	10V Output Calibration and Drift Rate for one new 732B
732B-100I	Same as 732B-100 for international shipment
732A-200	On-Site 10V Calibration w/Fluke Standard (includes shipping)
732A-201	Calibration of each additional 10V output at same site, requires 732A-200

More Than Just a Standard, Fluke Provides You with the Volt – the Total Solution to a Standards Problem

Given proper equipment and knowledge, it is surprisingly simple to maintain a fractional-ppm voltage standard. Fluke has maintained its Corporate Volt in the mean of four 732A Solid State References for the past six years. Figure 1 depicts the intercomparison system used in its Primary Standards Lab. Required knowledge, both theoretical/statistical and practical/experimental, has been translated into software for reducing and interpreting data from intercomparison of reference standards and other standards.

Numerical averaging of the references, with frequent transfers to National Institute of Standards & Technology (NIST), have proved to be a powerful way to maintain a standards quality voltage reference. Averaging reduces the already low noise (0.03 ppm, 1 sigma) by a factor of two, and reduces the average drift rate. Repeated transfers to NIST have reduced the uncertainty in the Drift rate to ±0.016 ppm/year and the uncertainty in the average value to ±0.04 ppm relative to 10 volts as maintained by NIST. When combined with the 0.29 ppm uncertainty in absolute value reported by NIST, the total uncertainty in the Fluke volt is a respectable ±0.3 ppm.

From the beginning, Fluke has "shared the wealth" with its customers. Not content just to sit on one of the best voltage standards in the country, we have shared the benefits with customers through the Direct Voltage Maintenance Program (DVMP). Figure 2 shows an actual transfer between Fluke and NIST, in which the transfer standard passed through five customer facilities (not shown) on its way to NIST. This state-of-the-art calibration service provides customers direct traceability to NIST, and is made possible by using Fluke's voltage reference to determine the drift and noise of the transfer standard. Typical transfer uncertainty in this program is about ±0.04 ppm, which allows calibration of customers standards with uncertainties of ±0.3 ppm.

The drift rate and value of a standard can be very well characterized with repeated calibration, linear curve fitting of the calibration results, and statistical analysis. Figure 3 shows the results for the Fluke Corporate Volt. Transfer uncertainty in this case is about ±0.04 ppm at 99% confidence – similar results are possible for customers' standards.

It is easy to evaluate how well a system actually performs in measuring other 10 volt references. Fluke does this for its system by assigning values to the transfer standards sent to NIST, then compares the NIST value. Differences should fall within computed uncertainty limits with 99% confidence. Figure 4 shows the excellent results obtained with Fluke's system. We can provide this service to customers who participate in the DVMP.

With the acquisition of a 10V Josephson Array Voltage Standard and the introduction of the 732B Solid State Reference Standard, the DVMP is even better than before. Traceability to natural physical constants (the Josephson Constant) can be provided with uncertainties of about 0.1 ppm or smaller. For those who still need NIST traceability, it is provided at the 0.3 ppm level. Repeated calibrations (without adjustment or repair) allow future output uncertainties to be predicted. Typical one year uncertainty after three annual calibrations is ±1.5 ppm. This value decreases with increased numbers of calibrations.

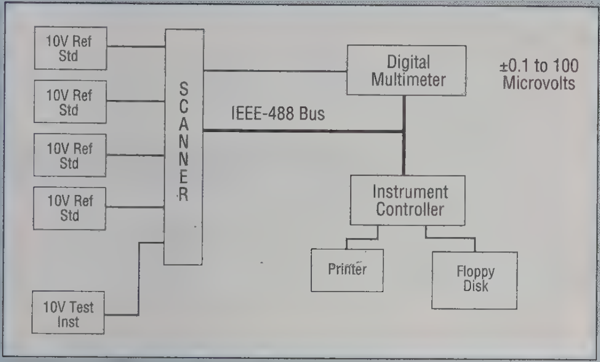


Fig. 1. Block diagram of the solid state reference intercomparison system.

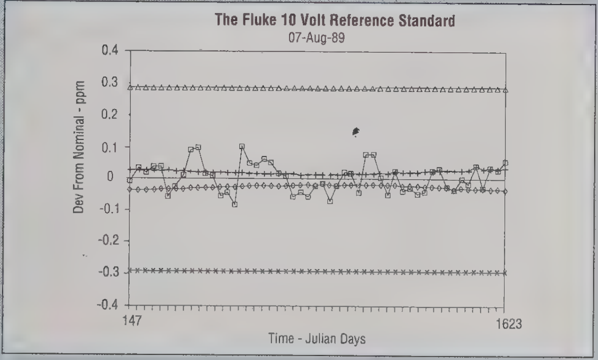


Fig. 3. The Fluke solid-state voltage reference – 18 transfers to NIST.

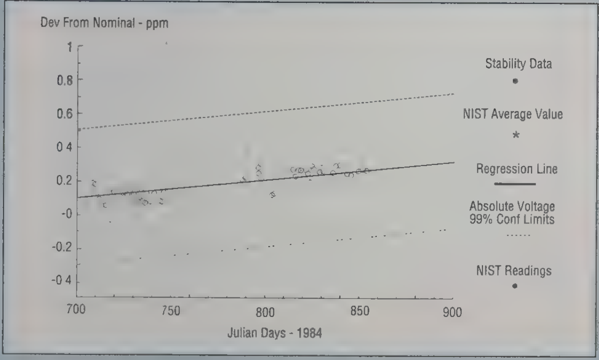


Fig. 2. Calibration of a transfer standard by NIST.

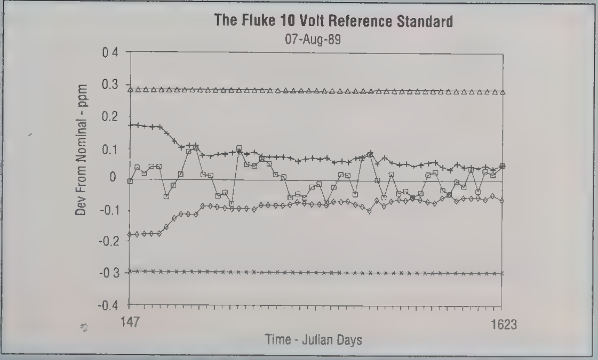


Fig. 4. Verifying the uncertainty analysis – 22 calibrations by NIST.

752A

(NSN 6625-01-175-1192) **752A**

752A Reference Divider

- 10:1 and 100:1 division ratios
- Ratio accuracy of 0.2 ppm on 10:1 ratio
- Ratio accuracy of 0.5 ppm on 100:1 ratio
- Built-in calibration bridge

The Fluke 752A Reference Divider sets the standard for direct voltage ratio accuracy and ease-of-use. It offers two divider outputs, 10:1 and 100:1 with output uncertainties of less than 0.2 ppm and 0.5 ppm respectively.

Before each use, the 752A is easily calibrated with only a stable voltage source and null detector like the Fluke 845AB or 845AR. The entire procedure requires only five minutes and does not require external standards.

The 752A also includes internal switching for calibrating the 100 mV, 1V, 10V, 100V, and 1000V ranges of a voltage calibrator to a 10V reference source (such as the Fluke 732B DC Standard) without having to change the lead connections. It provides the voltage division capability required to calibrate state-of-the-art calibrators and similar instruments.

A "self-calibration" procedure allows you to compensate for long term changes in value of the divider resistors by switching their positions in various Wheatstone bridge configurations and using the BALANCE pot on the front panel.

Specifications

These specifications apply for the lifetime of the instrument over the temperature range of 18°C to 28°C.

Ratio Ranges: 10:1 and 100:1

Ratio Accuracy: The following table specifies the ratio accuracies of the 752A that apply for a temperature variation of less than ±1°C from the self-calibration temperature (between 18°C and 28°C) for up to 8 hours following self-calibration.

Range	Input Voltage	Output Uncertainty	Null Accuracy*
10:0	0 to 100V	0.2 ppm	±0.5 µV
100:1	0 to 1000V	0.5 ppm	±1.0 µV

**Null accuracy refers to the required accuracy of the null detector reading during self-calibration*

Temperature Coefficient: ≤±1 ppm per °C over range of 18°C to 28°C (typically 0.1 ppm per °C from 15°C to 30°C)

Input Resistance

10:1 Ratio: 380 kΩ ±1%

100:1 Ratio: Divider is 4 MΩ; Driven Guard is 4 MΩ; total is 2 MΩ ±1%

Maximum Input Voltage: 200V for the 10:1 ratio; 1100V for the 100:1 ratio

Power Coefficient: ≤0.05 ppm of output with 100V applied for 10:1 ratio and ≤0.3 ppm of output with 1000V applied for 100:1 ratio (included in the ratio accuracy specifications)

Temperature: 0°C to 50°C, operating; -40°C to 75°C non-operating

Relative Humidity: ≤75% to 40°C, ≤45% to 50°C, non-condensing, operating; <100% 10-50°C, non-operating

Altitude: ≤3050m (10,000 ft) operating; ≤12,200m (40,000 ft) non-operating

Vibration: Per MIL-T-28800C, Type III, Class 5, Style E

Safety: IEC 348, 2nd edition, 1978; ANSI-C39.5, 1980, CSA 556B, and UL 1244

Size: 19.1 cm H x 22.1 cm W x 60.3 cm L (7.53 in H x 8.69 in W x 23.75 in L)

Weight: 8.4 kg (18.5 lb)

Ordering Information

Model

752A Reference Divider

Included with Instrument
Instruction manual.

Accessories (Also see Section 19)
5440A-7002 Low Thermal Copper EMF Plug-in Cables
845AB Voltmeter/Null Detector w/battery pack
845AR Voltmeter/Null Detector w/rack mount

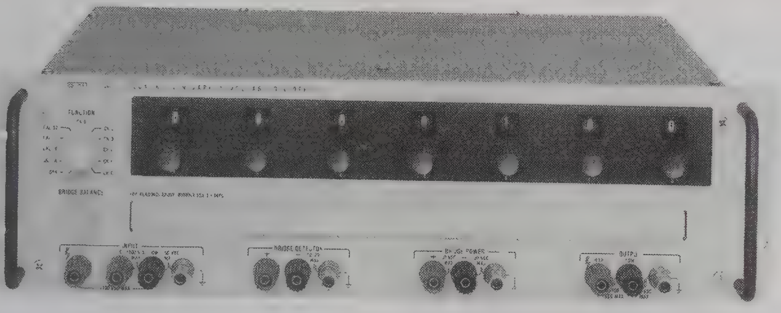
Manuals
752A Instruction*
845AB Instruction*
845AR Instruction*

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.



(NSN 6625-00-445-3329) **720A**

720A Kelvin-Varley Divider

- 0.1 ppm resolution, seven decades
- 0.1 ppm of input absolute linearity
- Built-in self calibration bridge
- Front panel self-calibration

Model 720A Kelvin-Varley Divider is a high-resolution primary ratio standard with absolute linearity of 0.1 ppm, temperature coefficient of linearity of 0.1 ppm/°C, and self-calibration capability.

Specifications

Ratio Range: 0 to 1.0 (1.0 input tap) and 0 to 1.1 (1.1 input tap)
Resolution: 0.1 ppm of input with seven decades
Absolute Linearity: (At calibration temperature and without the use of a correct chart) ±0.1 ppm of input at dial settings of 1.1 to 0.1, ±0.1 $(10S)^{1/3}$ of input at dial settings (S) of 0.1 to 0
Absolute Linearity Stability: (Without self-calibration) ±1.0 ppm of input/yr at dial settings of 1.1 to 0.1, ±1.0 $(10S)^{2/3}$ ppm of input/yr at dial setting (S) of 0.1 to 0

NOTE: Absolute linearity is defined as the linearity between max and min output voltages. The self-calibration procedure may be used at any time to reset absolute linearity to ±0.1 ppm of input.

Temperature Coefficient of Linearity: ±0.1 ppm of input/°C maximum at dial settings of 1.1 to 0.1
Short-Term Linearity Stability: Under typical conditions in a standards laboratory environment (temperature maintained within ±1°C) and with an applied voltage of up to 100V, stability of linearity is 0.1 ppm/30 days
Power Coefficient of Linearity: ±0.2 ppm of input/W max at dial settings of 1.1 to 0.1; ±0.2 $(10S)^2$ ppm of input/W max at dial settings (S) of 0.1 to 0
Maximum End Errors: Zero error at output low: 0.004 ppm of input. Zero error at input low: 0.05 ppm of input. Full-scale error: 0.05 ppm of input
Thermal Voltages: ±0.5 µV max
Maximum Input Voltage: 1000V on 1.0 input terminal, 1100V on 1.1 input terminal
Input Resistance: 100 kΩ ±0.005% at 1.0 input terminal at 25°C; 110 kΩ ±0.005% at 1.1 input terminal at 25°C
Temperature Coefficient of Input Resistance: ±1 ppm per °C max
Size: 14 cm H x 48.2 cm W x 33 cm D, rack mounted (5.5 in H x 19 in W x 13 in D)
Weight: 8.16 kg (18 lb)

Ordering Information

Model

720A Kelvin-Varley Voltage Divider

Included with Instrument
Line cord and Instruction manual.

Manual

720A Instruction*

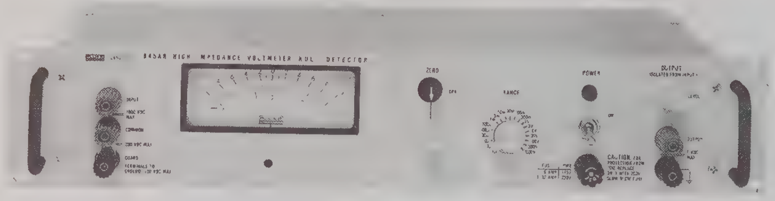
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

845AB & 845AR



(NSN 6625-00-257-7561) **845AR**

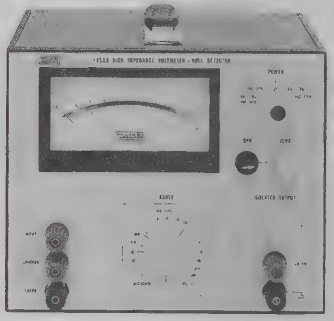
845AB & 845AR Null Detector

- 10 ranges from 1 µV through 1000V
- Input isolation greater than 10^{12} ohms
- Input may be floated to 1100V above ground
- Overload protected to 1100V on all ranges
- Recorder output isolated from input

The Fluke 845AB and 845AR are solid-state null detectors designed for extremely high input impedance, sensitivity, and isolation. Model 845AB operates either from the line or from built-in rechargeable batteries. Model 845AR is a line-powered rack-mounting version, with a height of 3 inches. Source loading through leakage is virtually eliminated by input isolation of 10^{12} ohms regardless of power line, chassis ground, or guard connections. Recorder output provides ±1V dc for end-scale deflection with ±0.5% linearity and does not affect input isolation. The 845AB and 845AR are capable of being floated up to 1100V dc from ground at either input terminal when used in a bridge circuit to compare voltage divider ratios. The unit withstands overloads up to 1100V dc on any range with a typical recovery time of four seconds.

Specifications

Range: 1 µV through 1000V dV end-scale in nineteen ranges, using 1, 3, 10 progression
Input Resistance: 100 MΩ on 300 mV range and above. 10 MΩ on 3 mV through 100 mV range, 1 MΩ on 1 mV range and below
Accuracy: Model 845AB ±(2% end-scale +0.1 µV). Model 845AR ±(3% end-scale +0.1 µV)
Maximum P-P Meter Noise: 0.20 µV on 1 µV range, 0.25 µV on 3 µV range, 0.3 µV on 10 µV to 1000V range, with input shorted
Input Isolation: Better than 10^{12} ohms at ≤50% relative humidity and 25°C regardless of line, chassis, or recorder grounding. Better than 10^{10} ohms up to 80% relative humidity and 35°C. With driven guard, isolation improves to at least 10^{13} ohms. Either input terminal can be floated 1100V off chassis ground.
DC Common Mode Rejection: Better than 160 dB, input short-circuited, ≤80% relative humidity; better than 140 dB, open-circuited, ≤50% relative humidity; better than 120 dB, open-circuited, ≤80% relative humidity
AC Common Mode Rejection: (Below 100 kHz) 100V rms or 120 dB greater than end-scale, whichever is less, will affect reading <2% of end-scale (input open-circuited)
AC Normal Mode Rejection: (60 Hz and above) ac voltages 60 dB above end-scale will affect reading <2% of end-scale. Maximum voltage not to exceed 750V rms.
Recorder Output: ±1V dc at full scale deflection. Linearity, 0.5%. Output impedance, 5K to 7.5K. Recorder output is isolated from input and is referenced to ground.
Stability of Zero: Better than 0.15 µV/hour; better than 0.3 µV/day
Overload Capability: Up to 1100V dc may be applied on any range. Typical recovery time is 4s



(NSN 6625-00-226-3718) **845AB**

Power, Model 845AR: 115 or 230V ac ±10%, 50 to 440 Hz, approximately 3W
Power, Model 845AB: 115 or 230V ac ±10%, 50 to 440 Hz or rechargeable battery. Approximately 6W during recharge. 40 hr operation on full charge. Batteries trickle-charge while instrument operates from power line.
Size, Model 845AB: 17.8 cm H x 21.6 cm W x 20.3 cm D (7 in H x 8.5 in W x 8 in D)
Size, Model 845AR: 8.9 cm H x 48.3 cm W x 21 cm D (3.5 in H x 19 in W x 8.25 in D)
Weight: Model 845AB: 4.65 kg (10.25 lb); Model 845AR: 4.08 kg (9 lb)

Ordering Information

Models

845AB Voltmeter/Null Detector w/batteries
845AR Voltmeter/Null Detector

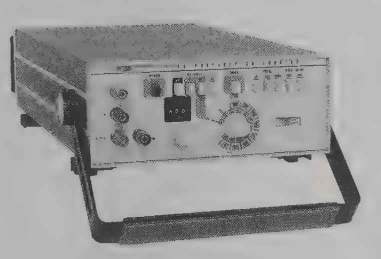
Accessories (Also see Section 19)
881A-103 7" Rack Mount Kit, Dual, for 845AB
5440A-7002 Low Thermal Copper EMF Plug-in Cables

Manuals
845AB Instruction*
845AR Instruction*
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.



(NSN 6625-01-086-2041) **515A**

515A Portable Calibrator

The Model 515A Portable Calibrator is a precision voltage and resistance calibration source for on-site calibration of measuring instruments. The 515A provides direct and alternating voltage and resistance standards in a unit only 3½ inches high by 8½ inches wide by 16 inches deep. The instrument weighs just 13 pounds, including the rechargeable battery pack, which eliminates warm-up delays after transit and allows 8-hour operation free of line power for true portability. The 515A basic uncertainty is specified over a temperature range of 18°C to 28°C for a 1-year period, thus making it easy to use in production test and calibration environments without complex correction terms. The long calibration cycle also makes the 515A economical to own by minimizing maintenance overhead costs.

All 515A outputs are available at a single set of output terminals. In addition, terminals are available to allow guarding and shielding of test leads in critical test situations.

If the unit is connected to the ac line, the internal battery is placed on charge; otherwise the 515A automatically operates from the battery and its state of charge is indicated on the meter to the right of the panel.

The 515A can be used effectively to test a wide range of characteristics in measuring instruments. Here are a few of the many applications:

dV: Input offset current, a/d linearity, absolute accuracy

aV: Frequency response, converter linearity, residual noise, absolute accuracy

Resistance: Linearity, residual resistance, absolute accuracy

General: Zero offset and stability, autoranging, overranging

Specifications

Direct Voltage

Ranges

µV: 0 to 99 µV continuous (0.2 µV resolution)
1V: 0 to 1.0V in 0.1V steps
10V: 0 to 10V in 1V steps
100V: 100V cardinal point

Uncertainty: (For 1 year, 18°C to 28°C, 30 min warm-up)
µV range: ±2 µV
1V, 10V, and 100V ranges: ±(0.003% of setting or 30 µV, whichever is greater)

Output Current: Function of source resistance, except 100V range which is limited at approximately 0.5 mA. No damage to instrument with short circuit on output.

Source Resistance
µV, 1V, 10V ranges: 300Ω
100V range: <1Ω (up to 0.5 mA load)

Alternating Voltage

Range: 1V, 10V, 100V cardinal points

Output Frequencies
10V: 400 Hz, 4 kHz, 50 kHz
1V, 100V: 400 Hz

Uncertainty: (For 1 year, 18°C to 28°C, 30 min warm-up)
1V: ±0.05%; 10V: ±0.04% at 400 Hz and 4 kHz. ±0.1% at 50 kHz; 100V: ±0.06%.

Frequency Accuracy: ±1% except at 50 kHz ±5%

Total Harmonic Distortion and Noise: <0.03% (400 Hz and 4 kHz), <0.05% (50 kHz)

Output Current
1V, 10V output: 0 to 10 mA rms
100V output: 0 to 0.5 mA rms

Resistance

Range: 10Ω through 10 MΩ in decade steps + zero setting

Uncertainty: (1 year, 18°C to 28°C, referred to "0" Ω position)
0Ω - Residual resistance is less than 0.15Ω
10Ω - 100Ω: ±0.06%
1 kΩ - 1 MΩ: ±0.015%
10 MΩ: ±0.075%

Power Rating: 0.2W or 100V (dc or rms), whichever is less

Temperature: 0°C to 50°C, operating

Power: 100, 115, 200, 230V ac, ±10%, 50 to 440 Hz, <10W, or internal batteries. Eight hours operation from batteries when fully charged.

Size: 8.9 cm H x 21.6 cm W x 40.6 cm D (3.5 in H x 8.5 in W x 16 in D)

Weight: 5.9 kg (13 lb)

Ordering Information

Model

515A Calibrator

Included with Instrument
One-year product warranty, line cord, Instruction manual, batteries, and Certificate of Calibration Practices.

Accessories (Also see Section 19)
M03-200-618 3½" Rack Mount Kit, Dual
M03-200-619 3½"Rack Mount Kit, Single, Offset

Manual
515A Instruction*

**No charge with purchase of unit*

A55

A55 Thermal Converter

Model A55 Thermal Converters make possible accurate thermal-transfer aV to dV measurements from sub-audio frequencies to the VHF region.

The Model A55-110 Accessory Kit is recommended for use with A55 Thermal Converters in virtually any calibration or measurement setup. The kit includes:

- Coaxial tee for A55 input (GR type 874-TL).
- Three coaxial adapters for A55 input: UHF, BNC, and type N jack.
- Interconnecting coaxial cable, as source to coaxial tee.

Voltage Ratings: 0.5, 1, 2, 3, 5, 10, 20, 30 & 50V*

** Each converter is useable from ½ to 1 times its rated voltage (rms)*

Uncertainty

Frequency	Calibration Uncertainty*	Typical aV to dV Difference
<1 MHz		<±0.01%
1 MHz	±0.05%	±0.01%
10 MHz	±0.10%	±0.01%
20 MHz	±0.15%	±0.02%
30 MHz	±0.20%	±0.10%
50 MHz**	±0.50%	±0.30%

** All calibration is referenced to center of GR 874-TL coaxial tee attached to converter input connector*
***50 MHz calibration available only for 0.5, 1, 2, 3, 5, and 10V converters*

Input Impedance: 200Ω/V, approximate
Output Voltage: 7 mV nominal, at rated input
Output Resistance: 8Ω
Reversal Error: <250 ppm (0.025%)

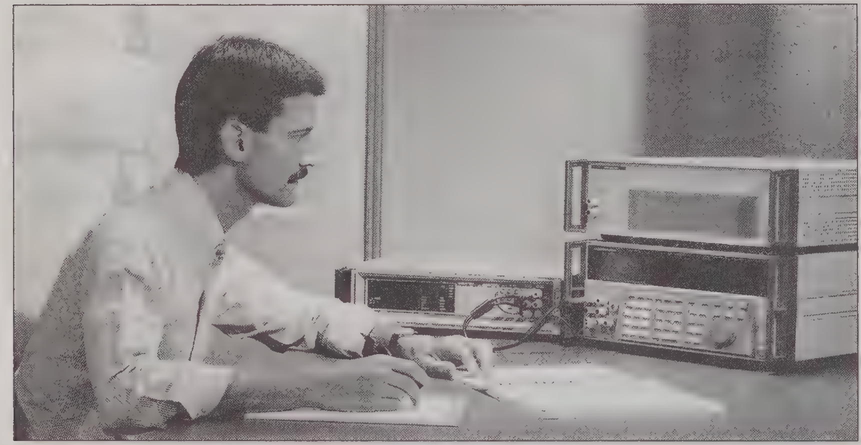
Model

A55* Thermal Converter

** Order by voltage rating, eg: A55-05V. Prices are for each converter*

Accessories (Also see Section 19)
A55-110 Accessory Kit
C55 Storage Case

Special Metrology Services



Metrology Services

State-of-the-art, primary standards laboratory

Traceability to NIST and Fluke's 10V Array

Cost-effective convenience

Fluke brings you the convenience of true service with the highest accuracy standards. Our goal is to help you make your calibration lab the best it can be.

Traceability Maintenance Programs

These innovative, on-site calibration services are offered to Fluke customers as a convenient means for maintaining traceability for your most accurate electronic measuring equipment.

Direct Voltage Maintenance Program

The Direct Voltage Maintenance Program has been in operation since 1984. This popular on-site service provides you with near-NIST accuracy for the 10-volt output of your dc reference standard without the inconveniences, cost and loss of use of sending your standard to NIST.

5700A Artifact Calibration Package

Designed for the smaller facility which does not want the expense of owning and maintaining the 10-volt standard and resistors needed for periodic Artifact Calibration of the 5700A. We will send you a characterized 732Aor 732B, 742A-1, and 742A-10k, plus the connecting cables and instructions you will need.

Standards Calibration Services

Send in your standards, we measure them and report their value. If your standard requires repair, arrangements are made with you to most effectively bring your standard back into specification. For information on any of these programs, contact your local Fluke representative.

Fractional ppm Traceability Using Your 734A

If you are setting up a multiple-reference primary voltage standard, the Fluke 734A provides a proven and flexible low-risk approach that builds on the experience of many other users.

It is good metrology practice to base your primary voltage standard on multiple independent references that you periodically intercompare. With only one standard you have no way to know if it has developed a drift problem. With a second one, you can compare their values periodically, but will not know which one is at fault if they disagree. Three standards can "vote" to determine which one is at fault when you get an unexpected value. Many laboratories maintain their standard in three instruments which never leave the laboratory. A fourth instrument can then be used as a working standard, as a backup in the event one of the primary instruments fails, or to transfer accuracy from their supporting facility.

As you can see in Figure 1, there are also some practical reasons why it is a good idea to have your primary references in physically separate enclosures. Your lab loses the use of an instrument when you send it out for calibration, often for a month or more. If you send only one of them, the others remain available. More importantly, they serve as a check on the one you sent out when it returns. And if one standard fails, it can be sent out for repair without interfering with the use of the others.

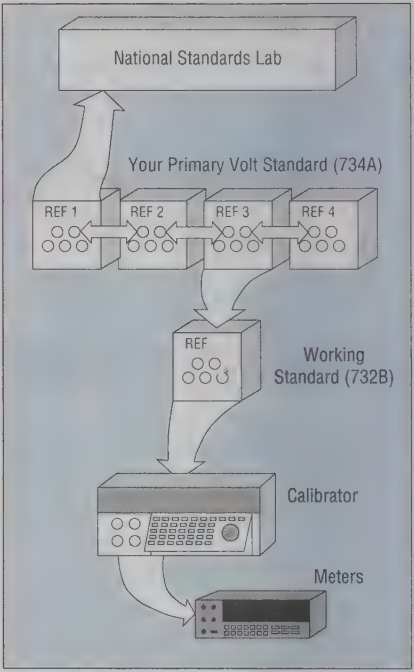


Figure 1. True independence is very practical, as well as good metrology.

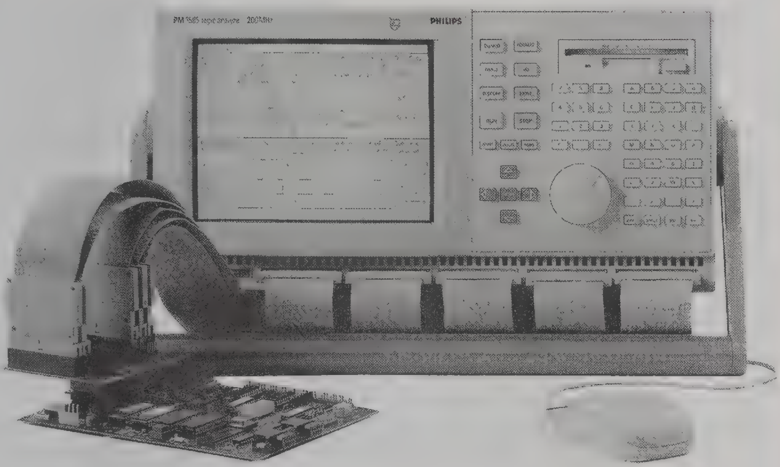
It is especially important to use a single reference for your working standard when you send it out of the lab for on-site support of other calibration instruments. You may need to prove to an auditor which reference was used. Moreover, some of your primary voltage standards should always be kept in the lab so they can serve as a check for shifts caused by handling or environmental stress. For the application note, ask for the Fluke Technical Information Note (B0196) "Fractional ppm traceability".

Additional Information

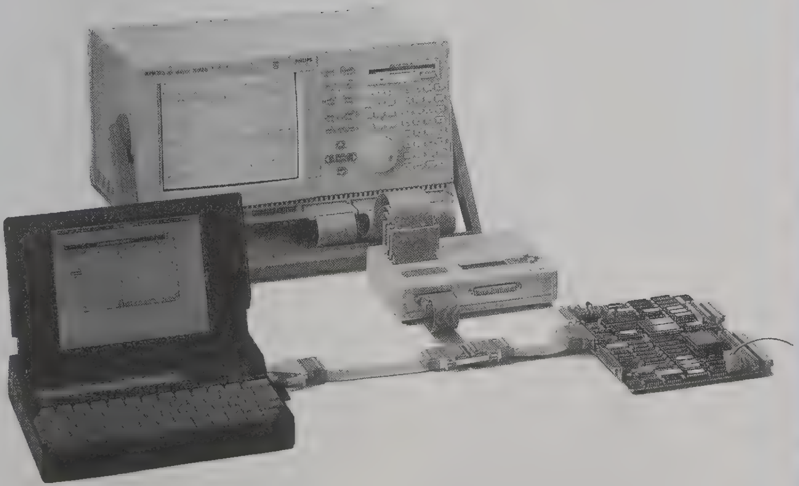
Numerous technical papers have been published about the Fluke 732A, here are a few:

- *A Primary Standard of Voltage Maintained in Solid-State References*, by Les Huntley.
- *Achieving an Ultra Stable Reference for Modern Standards and Calibration Instrumentation*, by Steve Haynes.
- *10 Volt MAP Using Electronic Reference Standards*, by Dave Agy and Les Huntley.
- *The Fluke Direct Volt Maintenance Program*, by Les Huntley.
- *A Preliminary Evaluation of the Accuracy of 10 Volts as Maintained on the West Coast of the United States*, by Les Huntley and Dave Agy.
- *On an Application For a Solid-State Reference Standard*, by Les Huntley, Ray Kletke, Clem Penco, and Dave Agy.

Logic Analyzers



PM 3585 Page 273



Bus Analysis Page 282

With its award-winning PM 3580 Family of logic analyzers, Fluke offers users optimum efficiency and cost-effectiveness for a wide range of digital development, manufacturing and service applications. These instruments all offer powerful state and timing analysis capabilities for verifying system functioning and for locating hardware and software faults. Careful attention has also been given to ergonomics, ensuring that these high-performance instruments are simple to use.

With the innovative PM 3580 Family of analyzers, the time taken to connect up to the Unit Under Test and set up the measurement has been reduced to an absolute minimum. The unique dual-analysis-per-pin architecture allows both state data (relating to software functioning) and timing data (relating to hardware performance) to be acquired simultaneously on each of up to 96 channels of the system under test, using just a single set of probes. Operation is made easy by a simple, intuitive user interface based on well-proven principles taken from the best in PC software.

A wide and growing range of quick-connect hardware and disassembly software is available covering all the major microprocessors and buses.

Introduction Page 272

PM 3580/85 Family Page 273

Processor Support Page 279

Bus Analysis Page 282

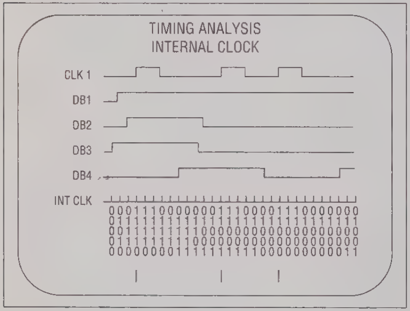
Introduction

Today, digital technology is replacing analog in products in virtually every field; from consumer audio products and domestic appliances to professional products and systems of every possible kind. The logic analyzer is an essential tool for debugging or repairing digital boards during all phases of the product lifecycle.

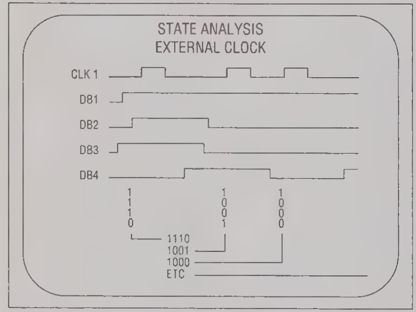
So What Does A Logic Analyzer Really Do?

"Logic Analyzer" is really a misnomer – *you* are the analyzer. The job of the logic analyzer is to give you the digital data you need as FAST as possible, and in the form you need it. Then you can analyze it to verify the operation of your board or track down problems.

There are two basic ways a logic analyzer can acquire data:



Timing analysis refers to data acquired using the *internal* sampling clock of the analyzer (see upper diagram). Data is stored *asynchronously* to events in the Unit Under Test (UUT).



State analysis refers to data acquired using an *external* sampling clock from the UUT (see lower diagram). Data is stored *synchronously* to events in the UUT.

State analysis is typically used for analyzing program flow or bus traffic, and as the diagrams show, is much more economic with data memory – so data over a much longer period of time can be stored. However, if the state data show a fault, the essential timing data – between the state clocking moments – has been lost. Timing analysis will generally be needed to track down the problem.

The data, whether state or timing, is generally displayed in one of two forms.

Waveform display is the usual way of viewing timing data since it offers an easy visual way of checking signal timing and measuring time differences. It can also be useful for state data to give a more visual impression of program or bus activity.

List display is typically used for state data, sometimes together with *disassembly* of numeric program code into instruction mnemonics. It can also be useful for timing data, for example when you are interested in bus "values" as a function of time.

Interpreting "Banner Specifications"

If you are considering buying a logic analyzer, it is important you understand the specifications. A close examination of some products will reveal major trade-offs in performance as features are used in various combinations.

Some manufacturers prefer to simplify the presentation of their products to facilitate the sales process, when in reality, a user's applications may be complex. With only key or "banner" specs presented, you might easily overlook important points in the evaluation of a product's true performance in a real application.

What are some of the key performance criteria to consider when buying a logic analyzer? Some are obvious while others may be buried in the specifications.

State and Timing Speeds and any tradeoffs with channel width, memory depth, glitch capture or time tagging

Simultaneous state/timing data storage, or just switchability between state/timing.

Number of Channels and any speed tradeoffs.

Memory depth, storage mechanism (transitional or conventional) and any tradeoffs with time tagging or speed.

Set-up and Hold Times for all features.

Probe loading and its effect on signal capture performance.

For example, an engineer with a 32-bit 35 MHz design (80-90 microprocessor signals) is considering a 100 channel modular analyzer offering 100 MHz state and 400 MHz timing, with channels switchable between state and timing. Sounds good? Maybe, but 400 MHz might only be available on a fraction of the channels. If he finds a 35 MHz state problem and needs to see the timing data, he will need to reprobe and reprogram the analyzer.

But with the channels switched to timing analysis, he can't trigger on the state problem anymore. He will probably have to reprobe and reprogram the analyzer several times before he finds the problem. In the end, he will probably have to buy more channels, which is what the logic analyzer vendor wanted after all.

PM 3580 Family of Logic Analyzers

The PM 3580 Family of logic analyzers have been optimized for giving you FAST ANSWERS on a wide range of applications.

There are 5 models. Starting with the 32 channel PM 3580/30 which offers 50 MHz state, 100 MHz timing. Ideal for general purpose logic analysis, for example on an 8-bit processor application.

The top-of-range PM 3585/91, with 96 channels at 50 MHz state and 200 MHz timing, is suitable for the latest 32-bit technology.

All models have the unique dual-analysis-per-pin-architecture giving simultaneous state and timing data acquisition on every channel. You only need to connect up *one probe* per channel, make *one set-up* and learn *one human-interface*. The result is FAST ANSWERS to your complex problems.

Wide Range of Microprocessor and Bus Support

We offer a wide range of quick-connect adapters to help you hook up FASTER and more reliably to your application. The capacitive load, typically only 15 pF per pin for both state data and simultaneous timing data, is low enough not to interfere with your circuit, even at high-speeds.

Our microprocessor support is one of the most complete in the industry, with support for Intel, Motorola, AMD, TI, Zilog, Rockwell, Siemens, Hitachi and Philips, as well as for all the popular buses. For details see page XXX. If you don't see your microprocessor or bus listed, check with your local salesman. It may be in the pipeline, or we may be able to put you in touch with one of our 3rd party vendors who can help you.

Remote Control (SCPI based)

PM 3580 Family logic analyzers have been designed to be operated standalone. However remote control via GPIB/IEEE-488* or RS-232 is available for all models. For example, for automated lab measurements or remote diagnostics over a telephone line.

MS-DOS Utilities

We offer free MS-DOS utilities for converting screen graphics into PC readable files for use with word processors and graphic programs. There are also utilities that make it easy to expand the binary data files into easy-to-read ASCII files for post-processing on a PC. And an open format is used for symbol files to enable users to create/download symbol tables on a PC for use by the analyzer.

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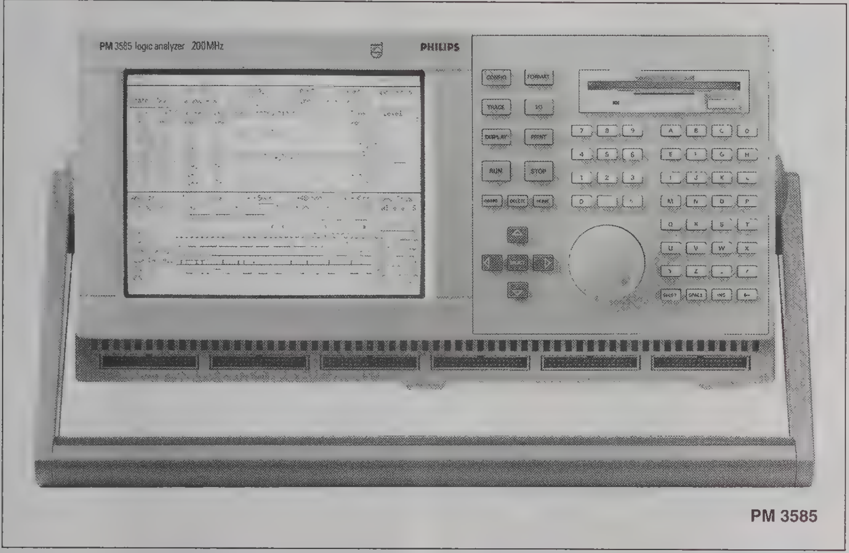
* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3580 Family

GPIB
IEEE-488

RS-232



PM 3585

PM 3580 Family Dual-Analysis-per-pin Logic Analyzers
Simultaneous 200 MHz timing / 50 MHz state on all channels
Fast connection and measurement set-up
Wide range of microprocessor and bus support options
Fully integrated state/timing trigger resources
Varied display capabilities including Symbolics and Graph
Glitch capture down to 3 nanoseconds
5 ns time tagging of state and timing data
Choice of 32, 64, and 96 channels
100 MHz timing versions available
Remote control via RS-232 or IEEE-488
MS-DOS utilities for Graphics and Post processing
JTAG/IEEE Std.1149.1 Boundary Scan Protocol Analyzer

Twice the Information, Half the Work

The PM 3580 Family represents a radical – yet affordable – step forward in logic analysis. These efficient general-purpose instruments offer state and timing capabilities powerful enough to tackle the latest 32-bit technology. What's more, they provide a new and more effective way to work with your device under test. Helping you find troublesome hardware and software problems – quickly.

Logic analyzers are typically used to debug digital designs, very often late in the design cycle when the software and hardware are being used together for the first time. Or, in repair labs, for tracking down sophisticated bugs which defy conventional repair equipment.

If a board functions incorrectly, it could be in the software (state analysis) or hardware (timing analysis). So to investigate the cause of a bug, both state and timing data are generally needed. However, most logic analyzers require two set-ups, two probes and switching between state and timing modes to provide this. Making logic analysis slow and frustrating.

PM 3580 Family logic analyzers give you all the data you need with one probe, one set-up, and one user-interface. Twice the information, half the work, and none of the usual frustration.

A New Concept in Logic Analysis

The PM 3580 analyzers have a unique dual-analysis-per-pin architecture, which allows them to store both state and timing data on each of up to 96 channels – in a single acquisition! That means no more dual-probing, no more repeat measurements, and no more incomplete data.

The unique PM 3580 Family architecture involves no specification compromises. You get 100 or 200 MHz timing acquisition with efficient transitional storage, and 50 MHz state acquisition on all channels. All the time. There's no longer any need to trade speed for width. And glitches as small as 3 ns can be captured on all channels, without trading off timing resolution.

You get a full 2K data memory per channel on the PM 3585 (1K on the PM 3580), for storing states, timing data or both as you require. And 5 ns timestamp data, stored in a separate memory, is always available, without trading in state speed or memory depth.

Both state and timing data – whether or not you want to store them – are available at all times for triggering the analyzer, giving you unprecedented power to capture the specific data you need.

And finally, the operation of the PM 3580 Family analyzers is faster, more intuitive and easier-than-ever to learn, with a modern human interface that uses the same principles as today's best PC software.

Analyzers That Fit Your Application

Whether you are repairing simple digital circuits or debugging state-of-art systems, there's a PM 3580 Family analyzer to help you solve your problems:

PM 3585/31 - 32 dual-analysis channels with 200 MHz timing and 50 MHz state

High-performance timing analysis and 8-bit microprocessor analysis. Can be divided into two logically separate analyzers each with 16 dual-channels (state *and* timing) – for example for monitoring separate asynchronous sections of a circuit.

PM 3585/61 - 64 dual-analysis channels with 200 MHz timing and 50 MHz state

As PM 3585/30, but with sufficient channels for 16-bit microprocessor applications. Or split into two logically separate analyzers for monitoring asynchronous operation of two processors or a processor and an external bus.

PM 3585/91 - 96 dual-analysis channels with 200 MHz timing and 50 MHz state

This top-of-the-line model offers the same capabilities as the PM 3585/60, plus the additional capability to handle 32-bit processors.

PM 3580/30 - 32 dual-analysis channels with 100 MHz timing and 50 MHz state

Logic analysis at its affordable best, for less demanding applications. Basic logic timing measurements and analysis of 8-bit microprocessor systems.

PM 3580/60 - 64 dual-analysis channels with 100 MHz timing and 50 MHz state

As PM 3580/30, but with sufficient channels for 16-bit microprocessor applications.

PM 3580 Family

Dual-Analysis Channels Go Further

When you choose a PM 3580 Family logic analyzer, remember that you need fewer channels than with a conventional logic analyzer. For example, if you were working with an 80286-based system using a conventional analyzer, you would need 48 channels for state analysis plus, say, another 32 for timing analysis – a total of 80 channels.

With a 64-channel PM 3580 or PM 3585 analyzer, 48 channels are all you need for the essential state and timing analysis of the 80286. You still have a further 16 channels to acquire other data, for example, for timing analysis of glue logic. Or for state and timing analysis of an external bus! And with a 96-channel PM 3585, you can acquire all the state and timing information you need (for example for disassembly and bus timing) from most advanced 32-bit processors, and still have 16 channels left over for glue logic.

Fast to Learn

In less than 30 minutes you've mastered the basic operation of the PM 3580 Family. With full integration of state and timing, you only have one human interface to learn. When you learn how to set a timing trigger word, you know how to set a state trigger word. Both are selected from the same pop-up menu.

The pop-up menus are designed to guide you through the set-up of the product. As you gain experience, the analyzer lets you use short cuts that are faster but still intuitive. For example, typing "T" to move a cursor to the trigger point.

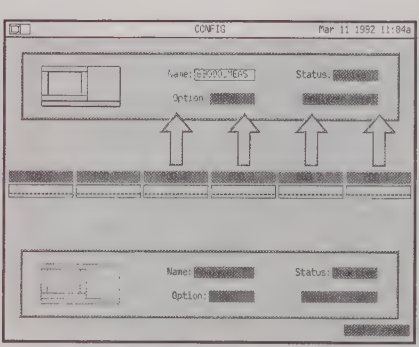
Fast, Reliable Connections

With one probe connection for both state and timing data, you avoid time-consuming, multiple probing. Less probes means you get more secure probe contacts and less probe loading to avoid masking your bug, or even causing the system to stop working altogether.

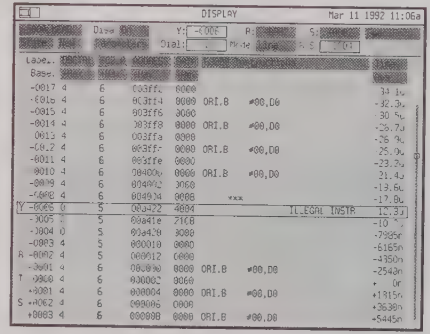
Microprocessor or bus quick-connect adapters for the PM 3580 Family offer capacitances of typically only 15 pF per channel and reduce the connection problem to a minimum.

Conventional analyzers with quick connectors for state-only data can add as much as 100 pF load to each channel. Double probing to get timing data compounds the problem. If this loading masks the bug, your only option will be to use individual clips for the state data too. In the 80286 example above, you would have to make 94 individual connections, 32 of them dual-probed. The chance is high that at least one connection will be incorrect, or insecure. Again, time-consuming and frustrating set-up.

With the PM 3580 Family's low-capacitance quick-connect adapters, the operation of the analyzer reduces to CLIP, FLIP, and RUN. CLIP on to the chip with the adapter, FLIP the power switch on and the analyzer will configure itself to your microprocessor set-up, push RUN and you obtain both disassembled state and complete timing data. Select a trigger condition from timing or state or both, and view both state and timing information to uncover the source of the bug. Logic analysis couldn't be easier.

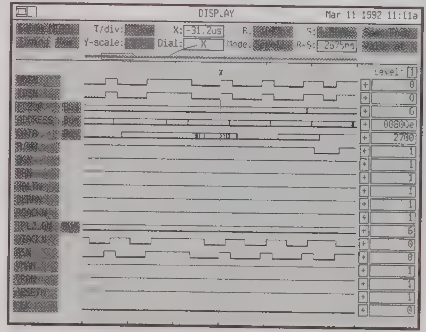


The PM 3580 Family analyzers make it easy to display the data you need, in the form you need it. Just read-in the standard microprocessor set-up from floppy disk, and press RUN.



```
  -0017 4     6    003ff2  0000                         -34.1u
  -0016 4     6    003ff4  0000 ORI.B    #00,D0         -32.3u
  -0015 4     6    003ff6  0000                         -30.5u
  -0014 4     6    003ff8  0000 ORI.B    #00,D0         -28.7u
  -0013 4     6    003ffa  0000                         -26.9u
  -0012 4     6    003ffc  0000 ORI.B    #00,D0         -25.0u
  -0011 4     6    003ffe  0000                         -23.2u
  -0010 4     6    004000  0000 ORI.B    #00,D0         -21.4u
  -0009 4     6    004002  0060                         -19.6u
  -0008 4     6    004004  0008       ***               -17.8u
Y -0006 0     5    00a422  4004              ILLEGAL INSTR  12.3u
  -0005 0     5    00a41e  2108                         -10
  -0004 0     5    00a420  0000                         -7985n
  -0003 4     5    000010  0000                         -6165n
R -0002 4     5    000012  0000                         -4350n
  -0001 4     6    000000  0000 ORI.B    #00,D0         -2540n
T  0000 4     6    000002  0060                         +   0n
  +0001 4     6    000004  0000 ORI.B    #00,D0         +1815n
S +0002 4     6    000006  0000                         +3630n
  +0003 4     6    000008  0000 ORI.B    #00,D0         +5445n
```

All the standard 68000 labels are visible on the display. If you see something wrong...

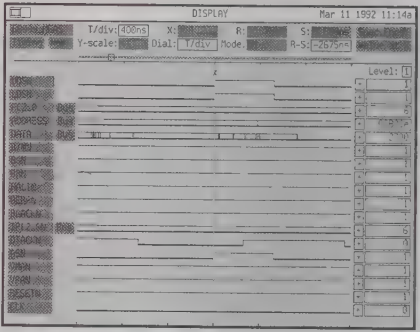


...just switch-over to see the actual signal timing for the same labels. This display shows a noisy data bus transition.

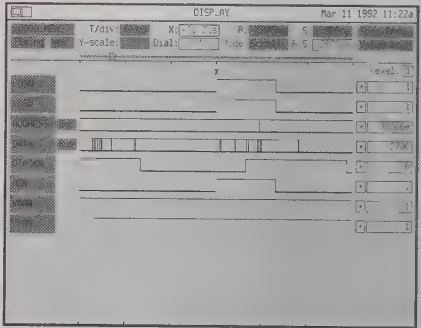
Fast Label Set-up

Often, you will want to customize the data for your application. By labelling data so that it relates to your circuit – for example defining clocks, interrupt lines and buses. And by using the trigger power of the logic analyzer to zoom-in on the data you are interested in.

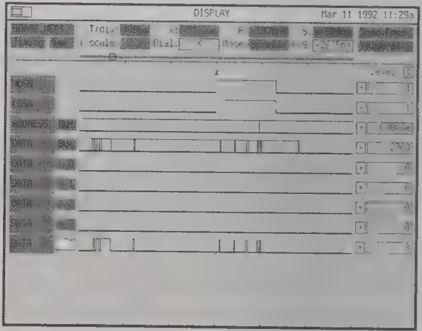
With the PM 3580 Family analyzers, entering data labels is as easy as typing the name and specifying one or a group of channels. With the full alphanumeric keyboard, even a whole list of labels can be entered quickly and conveniently.



Then scroll to the noisy bus transition and zoom to fill the display...



...INSERT the relevant timing signals in the appropriate place. DELETE the rest - in this case focus on the data bus.



Zoom in on the source of the problem by simply toggling through the data lines to see which ones are noisy. This reveals a problem on data line 7.

While with the optional microprocessor support packages, labelling is handled fully automatically.

Synchronous (state) clock definition is done in exactly the same way. Clocks can be selected from any of the data channels, and can be qualified by any (or all) channels. Once you define a state clock, the analyzer will automatically monitor state data – fully time-correlated with the timing information.

Fast Trigger Set-up

As well as acquiring state and timing data on all channels at once, the new dual-analysis-per-channel architecture also gives you a single, simpler trigger sequencer. Traditional analyzers need separate trigger sequencers for state and timing data acquisitions, with only loose links, if any, between them.

The sequencer of the PM 3580 Family has 8 levels, each of which may contain a mixture of state and timing trigger events, all organized in a easy-to-read, English-language style. Trigger words are arranged just like data labels, for easy definition.

For the easiest trigger set-up, just select from a pre-defined list of the most commonly used trigger sequences, enter the trigger words, and hit "RUN".

Or for more sophisticated triggering, you can switch to "user-defined" mode. Start from scratch, or use a pre-defined sequence as a starting point. Select patterns, ranges, time-filters, and more – all in a single sequence. And any level can wait for, and/or send, an external trigger pulse.

Selective storage control (global or per level), lets you zero in on specific data of interest, or filter out unwanted states (eg. idle loops), to maximize the effective use of data memory.

Fast Analysis

You only need to define the data labels once, to be able to view them in both state and timing displays. Even at the same time, in split-screen mode. Or "post-define" labels after you've made an acquisition – for example to split a bus.

With a couple of keystrokes, you can tailor the displayed data to the precise form and layout you require. Like rearranging labels to put two signals of interest alongside each other. Or displaying a label in both hex and ASCII.

Time difference measurements can be made in no time using the intuitive cursor control features. And measured data can be compared, automatically if required, with data in the reference memory.

Powerful Software Debug Features

Symbolic display and full disassembly let you relate to the data acquisition in high level terms. The symbolic table is an MS-DOS file that you can prepare on any PC.

For most processors PM 3580 Family disassemblers offer two modes, bus disassembly or the actual program flow compensated for pipeline activity. This mode removes instructions that are flushed and not executed from the display.

For an overview of software activity, you can display labels in graph form. For example, when plotting the address bus value of a subroutine, you can quickly see when the program jumps from the subroutine. Or use the graph mode to plot the activity of a DSP or A/D converter against time.

Microprocessor and Bus Support

To allow the PM 3580 Family analyzers to keep up with increasing bus speeds, a new range of ultra low-capacitance passive and semi-passive adapters – typically only 15 pF per pin – have been developed. In most cases, these can simultaneously capture both state and timing data from all signal lines. In special cases like the i386™ and i486™, where the clock timing of the processor requires active adapter circuitry, a separate adapter is available for the pure timing information.

Support packages, including quick-connect adapters and disassembly software, are available for a wide and growing range of micros and buses.(See page **282**)

Transitional Timing

All PM 3580 Family models incorporate the transitional timing principle, which ensures that timing data memory is always used optimally. Instead of continually storing identical data records, data is only stored when a change takes place, together with the time reference at the moment of change.

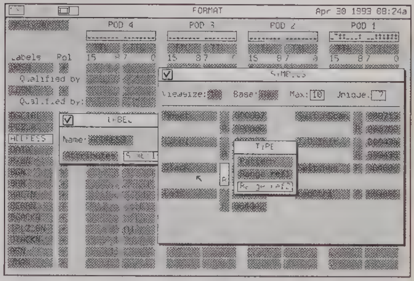
In transitional timing, data is always stored at the highest possible resolution (5 ns for the PM 3585 analyzers). Memory depth is automatically adjusted to the speed of the recorded signals. For very fast signals, transitional timing gives the same recorded length as for a conventional timing analyzer with the same memory size. However, for slower signals, storage of up to seconds or even hours of data is possible.

Two Logical Analyzers In One

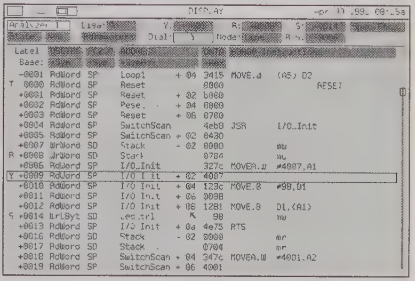
The PM 3585 models can be divided into two logically separate logic analyzers at any 16-channel boundary. Each analyzer operates as an independent instrument, with independent state clocks, and acquires both state and timing data on every channel. State and timing data are tightly correlated to a resolution of up to 5 ns.

Each analyzer also has its own trigger sequencer. At every trigger level, one analyzer section can wait for a trigger from the other, or can generate a trigger for the other.

This dual analyzer capability is particularly valuable for troubleshooting multi-bus systems, for example with a microprocessor and a peripheral bus. The two analyzers can be programmed to capture the relevant data from the two asynchronous systems, even when widely separated in time, allowing the problem to be rapidly located in the microprocessor section or the peripheral.

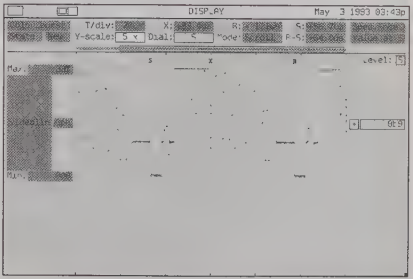


Symbols help you quickly identify specific areas of code, or to "tag" specific data values. Define them manually, as here, or import a PC-generated symbol file.



```
  -0001 RdWord SP  Loop1      + 04 3415 MOVE.W  (A5) D2
T  0000 RdWord SP  Reset           0000                  RESET
  +0001 RdWord SP  Reset      + 02 b000
  +0002 RdWord SP  Pese.      + 04 0000
  +0003 RdWord SP  Reset      + 06 0700
  +0004 RdWord SP  SwitchScan      4eb9 JSR     I/0_Init
  +0005 RdWord SP  SwitchScan + 02 0430
  +0007 WrWord SD  Stack      - 02 0000         mw
R +000B WrWord SD  Stack           0704         mw
  +0006 RdWord SP  I/0_Init        327c MOVEA.W #4007,A1
Y +0009 RdWord SP  I/0 I it   + 02 4007
  +0010 RdWord SP  I/0 Init   + 04 123c MOVE.B  #98,01
  +0011 RdWord SP  I/0 Init   + 06 0098
  +0012 RdWord SP  I/0 Init   + 08 1281 MOVE.B  D1,(A1)
S +0014 WrLByt SD  Led.trl         98           mw
  +0013 RdWord SP  I/0 Init   + 0a 4e75 RTS
  +0016 RdWord SD  Stack      - 02 0000         mr
  +0017 RdWord SD  Stack           0704         mr
  +0018 RdWord SP  SwitchScan + 04 347c MOVEA.W #4001,A2
  +0019 RdWord SP  SwitchScan + 06 4001
```

In the display, the 3rd column shows the symbolic address with offset of the executed code, allowing the user to immediately locate an instruction in a specific area of code.



Graph display allows you to display values as a function of time; in this case the output of an ADC in a digital TV processing system.

Easy Connection to Other Equipment

The PM 3580 Family of logic analyzers makes it easy to connect external devices such as a DSO or emulator. A TTL pulse can be generated on the BNC socket at any trigger sequencer level, and any sequencer level can be programmed to wait for an external trigger input pulse.

PM 3580 Family

For example, an emulator can be used to set up a certain software condition which is known to cause an intermittent real-time problem, with the output from the emulator being used to trigger an initial level in the logic analyzer. The analyzer, running in auto-repeat mode, triggers itself and a DSO when the problem occurs. This technique provides the combination of both digital and analog data needed to trace the fault.

IEEE-488/RS-232C Remote Control

It is possible to control the PM 3580 Family logic analyzers remotely from a PC or Workstation via GPIB/IEEE-488* or RS-232C. IEEE-488 is standard on all 200 MHz models and optional on 100 MHz models, while RS-232C is standard on all models.

In either case the analyzer acts as a slave to a remote host. This could, for example, be an IEEE-488 controller running a suite of test programs. Or a distant PC operating the logic analyzer via a modem for remote diagnostics.

The basic IEEE-488.2 and SCPI commands are supported, as well as a wide range of custom commands. These offer, for example, extensive communication facilities between the controller and a local operator. Or give the controller access to the local intelligence of the analyzer, for example for automatic comparison of data from the Unit Under Test with data from a Known Good Board.

Specifications

Technical Specifications

Input Section

Probe Impedance: 200 kΩ/7 pF (typical)
Threshold Per 8 Channel: TTL, ECL or variable (-3.0V +12.0V)
Threshold Accuracy: ±2.5% of V*th ±150 mV
Threshold Overdrive: 150 mV
Minimum Swing Peak: 2x (300 mV +2.5% of V*th) to peak centered on V*th (V*th = selected threshold voltage
Maximum Input Voltage: ±50V peak
Channel to Channel Skew: <4 ns

Configurations

PM 3580 analyzers have a single analyzer with dual-analysis-per-pin architecture. PM 3585 analyzers can be split into 2 logically separate analyzers. Each analyzer can be assigned any or all of the available 16 channel pods, and can acquire state and timing data on all channels simultaneously.

Timing Analyzer

Sample Period: 5 ns (10 ns for PM 3580)
Sample Period Accuracy: 0.005%
Time Interval Accuracy: ±(Sample period + channel to channel skew +0.005% of time interval reading)
Min. Detectable Pulse: 6 ns (typical; 11 ns for PM 3580) 7 ns (guaranteed; 12 ns for PM 3580)
Storage Method: Transitional

Glitch Analyzer

Min. Detectable Glitch: 3 ns (typical) 4 ns (guaranteed)

State Analyzer

Number of External Clocks: 4[1]
Clock Edges: Rising, falling or any
Minimum Clock Pulse Width: 5 ns
Clock Repetition Rate: 50 MHz maximum
Set-Up, Hold Time: Data and clock qualifiers must be present ≥10 ns before, and remain present ≥0 ns after, the external clocking signal.
Max. Time-Stamp Error: ±(5 ns+0.005% of time interval reading)

[1] Selectable from any channel. Clock qualifier expressions defined by ANDing any/all input channels; up to 4 such expressions can be ORed together.

Data Memory Storage Modes

Data memory on the PM 3580 Family is separate from the time-stamp memory. State data is always time-stamped.

	PM 3585		PM 3580	
	No. of states	Timing data length[2]	No. of states	Timing data length[2]
Timing/State[3]	1024	5.12 µs /12 hrs	512	5.12 µs /6 hrs
State Only	2048	–	1024	–
Timing Only[4]	–	10.24 µs /24 hrs	–	10.24 µs /12 hrs
Timing/Glitch	–	5.12 µs /12 hrs	–	5.12 µs /12 hrs

[2] Minimum measurement length applies for signal rates >25 MHz. Maximum measurement length applies for very slow input signals. Maximum time-correlated length of state data: 2 days

[3] Timing/State storage: default if external clock is defined.

[4] Timing only storage: default if no external clock is defined.

Trigger Sequencer

Trigger sequencer for PM 3580 and for each logical analyzer in PM 3580. Note that all state and timing trigger recognizersare always available, even when that data type is not being stored.

Sequence Types: Pre-defined, User-defined, Restart
Pre-Defined Sequences: Selection from standard list of commonly used sequences
User-Defined Sequences: 8 trigger levels each of 2 trigger conditions (If, Else if)
Restart Sequences: 8 single condition trigger levels with global restart condition
Level to Level Delay: None
Trigger Conditions: Any ORed combination of either state or timing trigger recognizers, (NOT recognizers are first ANDed) or timeout counter. On satisfying a condition, control is passed to any other trigger level.
Acquisition Halt: State or timing data acquisition can be independently halted on satisfying any trigger condition
Counters: A total of 4 counters (1-65535) are available for use in any trigger condition as event count down or timeout counters.

Trigger Recognizers

Each recognizer (except Glitch and Edge) uses an ANDed combination of bit values (0, 1 or X) for all defined labels. Data can be entered in any radix, or symbolically.

Timing
Timing Words: 1 with 5 ns resolution (10 ns for PM 3580); 2 with timing filters (20 ns to 1.31 ms)
Edge Detector: Any ORed combination of any edges
Glitch Detector: Any ORed combination of glitches
Glitch/Edge Triggering: Isolated or during valid pattern which has been present for a minimum period

State
State Words: 8 (or 6 if timing filter words are used)
Range Recognizers: Range or NOT range. Range is defined as AND of range recognizers for any number of labels. Up to 32-bits per label allowed.
Immediate Recognizers: Each pair of state words (w1:w2, w3:w4 etc.) can be used to recognize adjacent words
Timeout Counter: 20 ns to 65536 ms
Trigger Positions: Pre-defined positions: Beginning, Beginning +25%, Center, End -25% or End of acquired state and timing data. Additionally, state and timing can each be arbitrarily delayed with respect to the trigger point in percent of memory, time (to a maximum of 65536 ms) or clocks (state only).
External Triggering: Each trigger level can trigger and/or be triggered by an external instrument (via BNC) or the other logical analyzer in the PM 3585.

Selective State Storage

Selective State Storage can be specified, either globally or per individual level, prior to the trigger point, using any ORed expressions of the following: Anystate, Nostate, State word, NOT state word, Range, NOT range, Qualified external clock

Acquisition Functions

Single: RUN key starts, Trigger sequencer or STOP key stops
Auto-Repeat: RUN key starts. Acquisitions repeated indefinitely at programmed intervals
Auto-Repeat Stop: STOP key, Compare/Noncompare
Auto-Repeat Delay: 1s to 65535s

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Status Display: If the analyzer does not trigger within 1 sec of starting an acquisition, a status pop-up appears indicating the progression through the trigger levels

Note: Each acquisition is time stamped with the absolute time of the measurement (trigger point)

Logic Probing

Dynamic Indication of Signal Status: High, low or changing

Label Formatting and Attributes

Label Names: Up to 8 character name defining signals or logical groups of signals (buses)
Max. No. Channels/Label: 32
Max. No. Labels: 120
Label Attributes: Validity for clocks, inhibit timing data acquisition, symbol definition

Symbol definition

Symbol Types: Pattern, Range
Symbol Lengths: 1 to 32 characters
Display Width: User-definable, Max (maximum defined symbol length), Unique (maximum length for unique symbol display)
Number of Symbols: Depends on symbol lengths. Eg. Minimum 1150 x 32 bit symbols; 2048 symbols of average length 7 characters
Data Entry: Via FORMAT menu, or PC-file import

Data Display

Display Modes: Single screen or dual screen. Each screen section can contain data of any type or source.
Data Type: Timing/state waveform/list
Waveform Display Mode: Refresh (new data replaces old) or accumulate (new data is overlaid on the existing waveform display)
Data Source: New measurement, reference measurement or comparison of new and reference measurement
Display Labels: Any labels defined in FORMAT, displayed in any order. Plus time relative to trigger point and/or time-difference list displays
Bus Labels: Can displays BUS (all channels overlaid), single channel or GRAPH of bus values between selectable min and max.
Display Labels Base: Binary, Octal, Decimal, Hexadecimal, ASCII, Symbolic (list displays)
Level Display: Current levels in trigger sequence are displayed
Measurement Cursors: R and S
Cursor Units: Time or samples
Dial Functions: Scroll, set R-cursor, set S-cursor, set R+S-cursors, set Time/division, set vertical scale
Dial Mode: Movement on each dial-click: Scroll, Edge, Trigger level, Division, Page, Glitch, Find pattern
Find Pattern: Any bit-mask, defined by label
Time/Division (timing): 3 steps per decade from 5 ns to 50 ks
Co-Scroll: Data in dual screen display can be scrolled synchronously in time or samples with user-defined offset

Data/Settings Storage

DOS-format 2.0 Mbyte (1.44 Mbyte formatted) or 1.0 Mbyte (750 Kbyte formatted) 3.5" floppy disk.

Hardcopy Output

Via centronics parallel printer output or to disk. Standard format supports most Epson compatible printers. Other printers via User Configuration file. Utility supplied for conversion to standard GIFsm format (GIF is a Service Mark of Alchemy Mindworks Inc.) for import into reports etc.

External Video Output

Monochrome VGA compatible, video output socket

External BNC Trigger

Active Trigger Level: High
Input Resistance: 100 KΩ
Minimum Pulse Width: 25 ns (typical)

External BNC Trigger Out

Active Trigger Level: High
Output Impedance: 50Ω
Pulse Width: 20 ns (typical)
Delay Between Trigger: Approximately 430 ns from condition true (at probe tip) to trigger out true

General Specifications

Display: 9" monochrome screen with 4-level greyscale; selectable screen-saver

Size
Excluding Handle: 220 mm H x 420 mm W x 360 mm L (8.7 in H x 16.6 in W x 14.2 in L)
Handle in Carrying Position: 220 mm H x 462 mm W x 482 mm L (8.7 in H x 18.2 in W x 19 in L)
Weight: 12 kg (26.5 lb)
Power: 140 VA peak/VA quiescent

Environmental Characteristics

Standards: MIL-T-28800 D, Type III, Class 5, Style E
Temperature
Rated Range of Use: 5°C to 40°C
Limited Range of Operation: 0°C to 55°C
Range of Storage and Transport: -40°C to 70°C
Relative Humidity: Operating: 15% to 90% non-condensing; storage and transport: 5% to 95% non-condensing
Altitude: Operating: 4500m (15,000 ft); storage and transport: 12000m (40,000 ft)
Vibration: Swept sine resonance search, 5 Hz to 55 Hz, 2g (rms), 15 minutes per axis, 10 minutes resonance dwell
EMI: VDE 0871 Class B, FCCA
Safety: Conforms to IEC 348 Class I, VDE 0411, CSA 556B
Note: These data do not apply to the disk media

Ordering Information

Models

PM 3580/30 Logic Analyzer, 32 Ch
PM 3580/31 Logic Analyzer, 32 Ch & IEEE-488
PM 3580/60 Logic Analyzer, 64 Ch
PM 3580/61 Logic Analyzer, 64 Ch & IEEE-488
PM 3585/31 Logic Analyzer, 32 Ch & IEEE-488
PM 3585/61 Logic Analyzer, 64 Ch & IEEE-488
PM 3585/91 Logic Anaylzer, 96 Ch & IEEE-488

Included with Instrument

Set of manuals (PF 8690/00), complete set of probes, cables and clips for each channel (PF 8600/20 and PF 8600/24, two each for 32 channel mainframes, four each for 64 channel mainframes and six each for 96 channel mainframes); one front cover with integrated accessory pouch (PF 8666/20).

RS-232C Remote Control Software

PF 8653/30 (System S/W 2.0 or later is required)

Upgrades

PF8652/20 UGK 32 Ch upgrade – PM 3580/3X to /6X
PF 8652/25 UGK 32 Ch upgrade – PM 3580/6X to /9X
PF 8653/20 UGK adds IEEE-488 communications to PM 358X/X0

Field installed, includes service installation

Family Overview

Model number	PM 3580/3x[2]	PM 3580/6x[2]	PM 3585/31	PM 3585/61	PM 3585/91
State/Timing Channels	32	64	32	64	96
16 Channel Pods	2	4	2	4	6
Timing Speed (MHz)	100	100	200	200	200
State Speed (MHz)	50	50	50	50	50
Data Memory (Kb/ch.)	1	1	2	2	2
Upgrade to 64-channels[3]	PF 8652/20	–	PF 8652/23	–	–
Upgrade to 96-channels[3]	–	–	PF 8652/24	PF 8652/25	–

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[1] *Mainframes are delivered with a complete set of logic pods, pod cables and measuring clips, front cover with integrated accessory pouch, operating software and manuals.*
[2] *Specify x= 0 for standard mainframe, x= 1 for mainframe including optional IEEE-488 interface*
[3] *Units for upgrade should be returned to the local Philips/Fluke sales office.*

PM 3580 Family

Accessories

PF 8600/20 16 Channel Logic Pod and Pod Cable 1
PF 8600/21 16 Channel Pod Cable 2
PF 8600/22 16 Channel Logic Pod 3
PF 8600/24 Mini-Measuring Clips (20 ea) 4
PF 8600/26 16 Channel Coax Cable for High Speed Signals
PF 8601/40 44-pin PLCC Clip to Socket Adapter
PF 8601/50 52-pin PLCC Clip to Socket Adapter
PF 8601/60 68-pin PLCC Clip to Socket Adapter
PF 8601/80 84-pin PLCC Clip to Socket Adapter
PF 8603/20 RC Compensated Connectors, 16 Channels (set of 10) 5
PF 8603/25 Termination Adapter for 20-pin 3 M-style Connectors 10
PF 8665/30 Mouse Support Package
PF 8666/20 Front Cover with integrated Accessory Pouch
PF 8669/20 Training Target
PM 8819/30 50 Double Channel Mini Clips (red) 8
PM 8819/90 32 Mini Measuring Clips (black) 7
PM 8902A/001 12V DC/AC Converter
PM 8903A/003 Power Converter Package (12V ac conv., battery, charges, and bracket)
TC 100 Instrument Transport Cart 9
TC 100-01 Opt. Power Strip
TC 100-02 Opt. Drawer
TC 100-03 Opt. CPU Bracket
TC 100-04 Opt. Power Strip, Drawer, and CPU Bracket

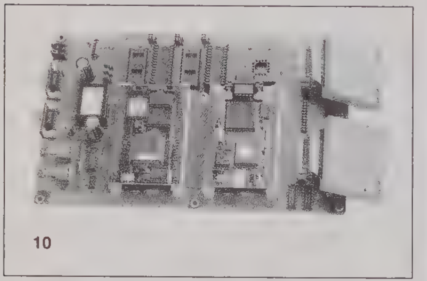
Custom Disassembler Development Software

PF 8629/30 Single-User Package
PF 8629/31 Multi-User Package
PF 8629/39 Upgrade to Version 1.02

Microprocessor Adapters

Including set-up software (if disassembler software is included the second to the last digit ia a 3 e.g. PF 86xx/3x)

PF 8610/30 8085 DIP Clip
PF 8611/30 6800/02/08 DIP Clip
PF 8612/30 6809/E DIP Clip
PF 8613/30 6502/12 DIP Clip
PF 8614/30 Z80 DIP Clip
PF 8615/30 8051 DIP Clip
PF 8615/32 8051 PLCC
PF 8615/82 8051 PLCC Ext. Socket
PF 8616/32 68HC11 PLCC
PF 8616/82 68HC11 PLCC Ext. Socket
PF 8617/32 Z80180/64180 PLCC
PF 8617/82 Z80180/64180 Ext. Socket
PF 8618/32 80515/35 PLCC
PF 8618/82 80515/35 PLCC Ext. Socket
PF 8619/32 68HC11F PLCC
PF 8619/82 68HC11F PLCC Ext. Socket
PF 8620/30 68000/10 DIP Clip
PF 8620/31 68000/10 DIP Socket
PF 8620/32 68000/10 PLCC
PF 8620/81 68000/10 DIP Ext. Socket
PF 8620/33 68000/10 PGA
PF 8620/82 68000/10 PLCC Ext. Socket
PF 8620/83 68000/10 PGA Ext. Socket
PF 8621/33 68302 PGA
PF 8621/34 68302 QFP Clip
PF 8621/83 68302 PGA Ext. Socket
PF 8622/32 68070 PLCC
PF 8622/82 68070 PLCC Ext. Socket
PF 8623/34 68HC162 QFP Clip
PF 8624/30 8086/88 DIP Clip
PF 8625/32 80C186/88 PLCC
PF 8625/82 80C186/88 PLCC Ext. Socket
PF 8625/33 80C186/88 PGA
PF 8625/83 80C186/88 PGA Ext. Socket
PF 8626/32 80286 PLCC
PF 8626/82 80286 PLCC Ext. Socket
PF 8626/33 80286 PGA
PF 8626/83 80286 PGA Ext. Socket
PF 8627/32 80186/88EB PLCC
PF 8627/82 80186/88EB PLCC Ext. Socket
PF 8628/32 MCS 96 PLCC
PF 8628/82 MCS 96 PLCC Ext. Socket
PF 8630/33 68020 PGA
PF 8630/83 68020 PGA Ext. Socket
PF 8631/33 68030 PGA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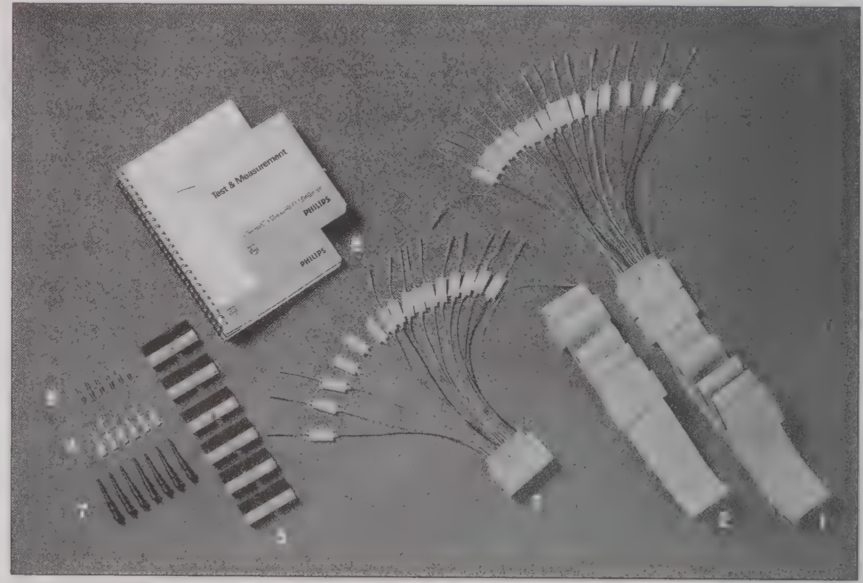

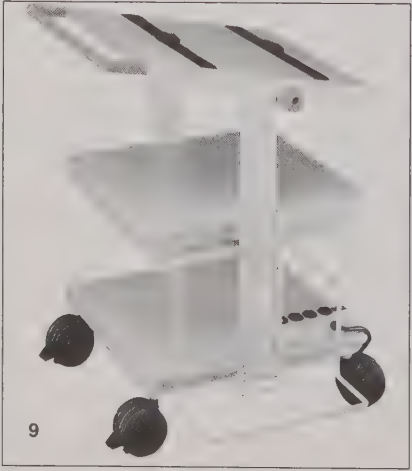
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PM 3580 Family

PF 8631/83 68030 PGA Ext. Socket
PF 8632/33 68040 PGA
PF 8632/83 68040 PGA Ext. Socket
PF 8634/23 i386DX Timing
PF 8634/24 i386 DX QFP Clip Timing
PF 8635/33 i386 DX State
PF 8635/83 i386 PGA Ext. Socket
PF 8636/23 i486DX/SX Timing
PF 8636/24 i486 DX/SX QFP Clip Timing
PF 8637/33 i486DX/SX State
PF 8637/34 i486 DX/SX QFP Clip State
PF 8637/83 i486 PGA Ext. Socket
PF 8644/23 i960CA PGA Timing
PF 8645/33 i960CA State
PF 8645/83 i960CA PGA Ext. Socket
PF 8647/33 Am29030 PGA
PF 8647/83 Am29030 PGA Ext. Socket
PF 8670/32 TMS 320C20/C2x PLCC
PF 8670/82 TMS 320C20/C2x PLCC Ext. Socket
PF 8670/33 TMS32020/C2x PGA
PF 8670/83 TMS32020/C2x PGA Ext. Socket
PF 8671/33 TMS 320C30 PGA
PF 8671/83 TMS 320C30 PGA Ext. Socket
PF 8672/34 TMS 320C31 QFP Clip
PF 8673/34 TMS 320C50/51 QFP Clip
PF 8675/34 56000 QFP Clip
PF 8675/33 56000/1 PGA
PF 8675/83 56000/1 PGA Ext. Socket
PF 8711/30 68008 DIP Clip
PF 8711/32 68008 PLCC
PF 8711/32 68008 PLCC Ext. Socket
PF 8714/32 H8/532 PLCC
PF 8714/82 H8/532 PLCC Ext. Socket
PF 8715/32 80C552/62 PLCC Socket Adapter
PF 8715/82 80C552/62 PLCC Ext Socket
PF 8717/32 H8/330 PLCC
PF 8717/82 H8/330 PLCC Ext. Socket
PF 8718/32 80C517/37 PLCC
PF 8718/82 80C517/37 PLCC Ext. Socket
PF 8719/32 68HC11G PLCC
PF 8719/82 68HC11G PLCC Ext. Socket
PF 8720/34 68331/2 QFP Clip
PF 8720/36 68331/2 20 Pin Adapter
PF 8721/34 68330 QFP Clip
PF 8721/34V 68330V QFP Clip
PF 8722/33 68340 PGA
PF 8722/33V 68340V PGA
PF 8722/83 68340 PGA Ext. Socket
PF 8723/32 68EC000 PLCC
PF 8723/82 68EC000 PLCC Ext. Socket
PF 8724/24 386SX QFP Timing Adapter
PF 8725/34 386SX QFP State Adapter
PF 8726/32 80186/88 EA PLCC
PF 8726/82 80186/88 EA PLCC Ext. Socket
PF 8727/34 80186/88 EC QFP
PF 8728/35 80166 QFP Socket Adapter
PF 8729/32 80C196KR
PF 8730/33 68EC020 PGA
PF 8730/83 68EC020 PGA Ext. Socket

Bus Adapters & Disassembler Software

PF 8680/36 IEEE-488
PF 8681/36 I^2C and ACCESS.bus
PF 8682/36 RS-232C/RS-449
PF 8683/36 JTAG IEEE-1149.1 (Boundary Scan)
PF 8684/36 VME Bus
PF 8685/26 IBM 360/370 I/O Channel
PF 8686/26 AT Bus

Manuals & Latest System Software

PF 8690/00 English 6
PF 8690/10 French

Microprocessor Support

Microprocessor adapters plus disassembly software

Original Supplier	Main Processor Type	Package	Order No.	Maximum* Frequency	Pods** Disa/Full	Disa	Modes ***	Supported Processors	Electric Load on Processor Pins: 200 kOhms / 15 pF except on:	Extension Sockets
8-bit										
Hitachi	H8/330	PLCC-socket (68 pins)	PF 8717/32	20 MHz (Xtal)	2/4	yes	S/T	H8/330, H8/350	MIN, RESN, P5.0-P5.2, P8.2, P8.3: 200 kOhms / 20 pF (typ.); Other pins 200 kOhms / 16 pF (typ.)	PF 8717/82
	H8/532	PLCC-socket	PF 8714/32			yes	S/T			PF 8714/32
Intel	8051	DIP-clip	PF 8615/30	25 MHz (la)	2/3	yes	S/T	8031, 8032, 8051, 8052, 8053, 80533, 80513, 80C31, 80C32, 80C51, 80C52, 80C321, 80C521, 80C541, 80C652, 80C851, 83C51, 83C154, 83C652, 83C654, 83C851, 85C51, 86C00, 86C410, 8751, 8752, 8753, 87C51, 87C521, 87C528, 87C541	ALE: 200 kOhms / 25 pF (typ.)	
		PLCC-socket (44 pins)	PF 8615/32	30 MHz (Xtal)	2/3	yes	S/T	Same as above.	ALE, EA, PSEN: 200 kOhms / 20 pF (typ.)	PF 8615/82
	8085	DIP-clip	PF 8610/30	12 MHz (Xtal)	2/3	yes	S/T	8085, 80C85	None.	
Motorola	6800/02/08	DIP-clip	PF 8611/30	3 MHz	2/3	yes	S/T	6800, 68A00, 68B00, 6802, 68A02, 68B02, 6808, 68A08, 68B08	None.	
	68008	DIP-clip	PF 8711/30	20 MHz	3/3	yes	S/T	68008	IPL 2/0: 100 kOhms / 22 pF (typ.)	
		PLCC-socket (52 pins)	PF 8711/32	20 MHz	3/3	yes	S/T	68008	All signals: 200 kOhms / 17 pF (typ.)	PF 8711/82
	6809/E	DIP-clip	PF 8612/30	3 MHz	2/3	yes	S/T	6809, 68A09, 68B09,6809E, 68A09E, 68B09E	A0-A15: 200 kOhms / 30 pF (typ.)	
	68HC11 [4]	PLCC-socket (52 pins)	PF 8616/32	10 MHz (Xtal)	2/3	yes	S/T	68HC11A0, 68HC11A1, 68HC11A8, 68HC11E1, 68HC11E9, 68HC811E2, 68HC711E9, 68L11Ax, 68L11Ex	MODA/LIR: 67 kOhms / 25 pF (typ.): Other pins: 200 kOhms / 20 pF (typ.)	PF 8616/82
	68HC11F [5]	PLCC-socket (68 pins)	PF 8619/32	10 MHz (Xtal)	2/4	yes	S/T	68HC11F1	MODA / LIR 67 kOhms / 15 pF (typ.)	PF 8619/82
	68HC11G [7]	PLCC-socket (84 pins)	PF 8719/32	15 MHz (Xtal)	2/4	yes	S/T	MC68HC11G0, MC68HC11G5, MC68HC11G7, MC68HC711G5	t.b.d.	PF 8719/82
Philips	80515/35 [12]	PLCC-socket (68 pins)	PF 8618/32	20 MHz	2/4	yes	S/T	80512, 80515, 80532, 80535, 80C515, 80C535	ALE: 200 kOhms / 20 pF (typ.) PE: 200 kOhms / 25 pF (typ.)	PF 8618/82
	80517/37	PLCC-socket (84 pins)	PF 8718/32	20 MHz (Xtal)	2/5	yes	S/T	80C517, 80C517A, 80C537, 83C517A	ALE: 200 kOhms / 25 pF (typ.) PEN, RON: 200 kOhms / 20 pF (typ.)	PF 8718/82
	80C552	PLCC-socket (68 pins)	PF 8715/32	20 MHz (Xtal)	2/3		S/T	80C552, 83C552, 87C552, 80C562 83C562	ALE: 200 kOhms / 25 pF (typ.)	PF 8715/82
	80C592	PLCC-socket	PF8716/32					80C592		
Rockwell	6502/12	DIP-clip	PF 8613/30	3 MHz	2/2	yes	S/T	6502, 6502A, 6502B, 6512, 6512A, 6512B	None.	
Zilog	Z80	DIP-clip	PF 8614/30	10 MHz (la)	2/3	yes	S/T	Z80. Z84, Z84C, Z084, Z084C, MK3880, uPD780	None.	
	Z80180/64180	PLCC-socket (68 pins)	PF 8617/32	10 MHz	3/4	yes	S/T	Z80180, HD64180R1X, HD64X180R0, HD64180ZX	HALT, REF. ST, NIE, LIR, IOE: 200 kOhms / 20 pF (typ.)	PF 8617/82

PM 3580 Family

Microprocessor Support Microprocessor adapters plus disassembly software (continued)

Original Supplier	Main Processor Type	Package	Order No.	Maximum* Frequency	Pods** Disa/Full	Disa	Modes ***	Supported Processors	Electric Load on Processor Pins: 200 kOhms / 15 pF except on:	Extension Sockets
16-Bit										
Intel	8086/88	DIP-clip	PF 8624/30	10 MHz	2/3	yes	S/T	80C86, 80C88, uPD70108 (Nec V20), uPD70116 (Nec V30)	pin 19: >200 kOhms / 12 pF (typ.); pins 21,22,25-28,33: 200 kOhms / 30 pF (typ.); other pins: 200 kOhms / 20 pF (typ.)	
	80186/88	PLCC-socket (68 pins)	PF 8625/32	20 MHz	2/4	yes	S/T	80C186, 80C188, 80C186XL, 80C188XL	CLKOUT,RESET,ALE: 200 kOhms / 25 pF (typ.): S0-S2, TMRIN0, TMRIN1, PCS0-PCS6: 200 kOhms / 20 pF (typ.)	PF 8625/82
		PGA-socket (68 pins)	PF 8625/33	20 MHz	2/4	yes	S/T	Same as above.	CLKOUT,RESET,ALE: 200 kOhms / 25 pF (typ.): other pins: 200 kOhms / 20 pF (typ.)	PF 8625/83
	80186EA/88EA	PLCC-socket	PF 8726/32			yes	S/T	80C186EA, 80C188EA		PF 8726/82
	80186EB/88EB	PLCC-socket (84 pins)	PF 8627/32	20 MHz	2/5	yes	S/T	80C186EB, 80C188EB	CLKOUT,RESET,ALE: 200 kOhms / 25 pF (typ.)	PF 8627/82
	80186EC/88EC	QFP-clip	PF 8727/34			yes	S/T	80C186EC, 80C188EC		
	80286	PLCC-socket (68 pins)	PF 8626/32	50 MHz (CLK)	4/4	yes	S/T	80286, 80C286	CLK: >200 kOhms / 25 pF (typ.): S0-S2,PEACK, READY,RESET: 200 kOhms / 25 pF (typ.)	PF 8626/82
		PGA-socket (68 pins)	PF 8626/33	50 MHz (CLK)	3/4	yes	S/T	Same as above.	CLK: >200 kOhms / 20 pF (typ.): S0-S2,PEACK, READY,RESET: 200 kOhms / 20 pF (typ.)	PF 8626/83
	80C196KR	PLCC-socket	PF 8729/32			yes	S/T	80C196KR/KQ/NT/NQ/KT		PF 8729/82
	386SX	QFP-clip	PF 8724/24	80 MHz (CLK2)	-/4	no	T	386SX, 386SXL, 386SXLV, 376	CLK2: >200 kOhms / 15 pF (typ.); RESET: 200 kOhms / 25 pF (typ.); Other signals: 200 kOhms / 20 pF (typ.)	
		QFP-clip	PF 8725/34	80 MHz (CLK2)	4/4	yes	S/t	Same as above.	all signals 200 kOhms / 15 pf (typ.)	
	MCS-96[9]	PLCC-socket (68 pins)	PF 8628/32	20 MHz (Xtal)	2/4	yes	S/T	8096, 8097, 80C196, 8396, 8397, 83C196, 8797, 87C196	pins 40,41,62,64,65: 200 kOhms / 25 pF (typ.)	PF 8628/82
Motorola	68000/10[2]	DIP-clip	PF 8620/30	20 MHz	3/4	yes	S/T	68000, 68HC000, 68HC001 (n), 68010	LDS,UDS: 100 kOhms / 25 pF (typ.); A0 (68HC001 only): 67 kOhms / 15 pF (typ.)	
		DIP-socket	PF 8620/31	20 MHz	3/4	yes	S/T	Same as above.	Same as above.	PF 8620/81
		PLCC-socket (68 pins)	PF 8620/32	20 MHz	3/4	yes	S/T	Same as above.	Same as above.	PF 8620/82
		PGA-socket (68 pins)	PF 8620/33	20 MHz	3/4	yes	S/T	Same as above.	Same as above.	PF 8620/83
	68EC000[1]	PLCC-socket (68 pins)	PF 8723/32	20 MHz (CLK)	3/4	S/T		68EC000	t.b.d.	PF 8723/82
	68302[16]	PGA-socket (132 pins)	PF 8621/33	20 MHz	3/6+	yes	S/T	68302	LDS, UDS: 100 kOhms / 20 pF (typ.)	PF 8621/83
		QFP-clip	PF 8621/34	20 MHz	3/6+	yes	S/T	68302	LDSN, UDSN: 100 kOhms / 25 pF (typ.): other pins: 200 kOhms / 18 pF (typ.) 100 kOhms LSDN	
	68330[1]	QFP-clip (132 pins)	PF 8721/34	20 MHz (Xtal)	4/6	yes	S/T	68330A	t.b.d.	
	68330V	QFP-clip (low voltage)	PF 8721/34V	20 MHz (Xtal)	4/6	yes	S/T	68330 low voltage	t.b.d.	
	68331/2	QFP-clip	PF 8720/34	20 MHz	4/6	yes	S/T	68331, 68332	all signals: 200 kOhms / 20 pF (typ.)	
	68332EVS[1,15]	20-pin connectors	PF 8720/36	20 MHz (Xtal)	4/6	yes	S/T	68332EVS, 6833EVS	all signals: 200 kOhms / 12 pF (typ.)	
	68340	PGA-socket (145 pins)	PF 8722/33	20 MHz	4/6	yes	S/T	68340	ASN,CLKOUT,DREQ1-2N,DACK2N,DONE1-2N. 200 kOhms / 20 pF (typ.)	PF 8722/83
	68340V	PGA-socket (low voltage)	PF 8722/33V	20 MHz (Xtal)	4/6	yes	S/T	68340 low voltage		PF 8722/83
	68HC16[1]	QFP-clip (132 pins)	PF 8623/34	t.b.d.	t.b d.	S/T		68HC16	t.b.d.	
	68HC16Z	QFP-clip (132 pins)	PF 8623/34	20 MHz (Xtal)	4/6	yes	S/T	68HC16Z1, 68HC16Z2		
Philips	68070	PLCC-socket (84 pins)	PF 8622/32	35 MHz (Xtal)	3/5	yes	S/T	68070	UDS, LDS: 100 kOhms / 25 pF (typ.), BG, BGACK, T1: 200 kOhms / 20 pF (typ.)	PF 8622/82
Siemens	80166[12]	QFP-clip	PF8728/34	40 MHz (Xtal1,2)	3/5	yes	S/T	80C166	ALE. 200 KOhms / 25 pF (typ.). other pins: 200 kOhms / 18 pF (typ.)	
		QFP-socket	PF8728/35	40 MHz (Xtal1,2)	3/5	yes	S/T	80C166	ALE: 200 KOhms / 25 pF (typ.); other pins: 200 kOhms / 20 pF (typ.)	
32-bit										
Intel	386DX	PGA-socket (132 pins)	PF 8634/23	80 MHz (CLK2)	-/6	no	T	i386DX	CLK2: >200 kOhms / 15 pf (typ.); other signals: 200 kOhms / 25 pF (typ.)	PF 8635/83
		QFP-clip (132 pins)	PF 8634/24	80 MHz (CLK2)	-/6	no	T	Same as above.	RESET: >200 kOhms / 25 pf (typ.); other pins: 200 kOhms / 20 pF (typ.)	PF 8635/83
		PGA-socket (132 pins)	PF 8635/33	80 MHz (CLK2)	5/5	yes	S/T	Same as above.	all pins: >200 kOhms / 15 pF (typ.)	PF 8635/83
		QFP-clip (132 pins)	PF 8635/34	80 MHz (CLK2)	5/5		S/T	Same as above.	all pins: >200 kOhms / 17 pF (typ.)	
	486DX/SX[7]	PGA-socket (168 pins)	PF 8636/23	50 MHz	-/6	no	T	486DX, 486SX	all pins: >200 kOhms / 17 pF (typ.)	PF 8637/83
		PGA-socket (168 pins)	PF 8637/33	45 MHz	5/5	yes	S/T	Same as above.	all pins: >200 kOhms / 15 pF (typ.)	PF 8637/83
	486SX	QFP-clip (196 pins)	PF 8636/24	50 MHz	-/6	no	T	486SX	all signals: 200 kOhms / 18 pF (typ.)	
		QFP-clip (196 pins)	PF 8637/34	45 MHz	5/5	yes	S/T	Same as above.	all signals: 200 kOhms / 18 pF (typ.)	
Motorola	68020	PGA-socket (114 pins)	PF 8630/33	35 MHz	5/6	yes	S/T	68020	A0, A1: 200 kOhms / 20 pF (typ.)	PF 8630/83
	68EC020	PGA-socket (100 pins)	PF 8730/33	35 MHz (CLK)	5/5	yes	S/T	68EC020	CLK: 200 kOhms / 20 pF (typ.)	PF 8730/83
	68030[9]	PGA-socket (128 pins)	PF 8631/33	35 MHz (la)	5/6	yes	S/T	68030, 68EC030 (11 pins)	ECS: 200 kOhms / 20 pF (typ.)	PF 8631/83
	68040[7,16]	PGA-socket (179 pins)	PF 8632/33	25 MHz	6/6 +	yes	S/T	68040, 68EC040	BG, BB, RSTO, TCK, TMS: 200 kOhms / 20 pF (typ.) MDIS, CDIS: 200 kOhms / 30 pF (typ.)	PF 8632/83

Microprocessor Support Microprocessor adapters plus disassembly software (continued)

Original Supplier	Main Processor Type	Package	Order No.	Maximum* Frequency	Pods** Disa/Full	Disa	Modes ***	Supported Processors	Electric Load on Processor Pins: 200 kOhms / 15 pF except on:	Extension Sockets
RISC										
Intel	i960CA	PGA-socket (168 pins)	PF 8644/23	33 MHz	-/6	no	T	i960CA, i960CF	all pins: 200 kOhms / 25 pF (typ.)	PF 8645/83
		PGA-socket (168 pins)	PF 8645/33	33 MHz	5/5	yes	S/t	Same as above.	A28-A31, W/R: >200 kOhms / 25 pF; other pins: >200 kOhms / 15 pF (typ.)	PF 8645/83
AMD	29030 [7,16]	PGA-socket (145 pins)	PF 8647/33	40 MHz (MEMCLK)	6/6 +	yes	S/T	29030	REQ, RDY, BURST, RDN, MEMCLK, RESET: 200 kOhms / 25 pF (typ.)	PF 8647/83
IDT	3051 [3]	PLCC-socket (84 pins)	Corelis	Consult supplier	4/4	yes	S/T	IDT3051, IDT3051E, IDT3052, IDT3052E	Consult supplier	
DSP										
Texas Ins.	TMS 32020/C2x	PLCC-socket (68 pins)	PF 8670/32	50 MHz (CLKOUT)	3/4	yes	S/T	TMS32020, TMS320C25, TMS320C26, TMS320E25	DS, SYNC, MP/MC: 200 kOhms / 20 pF (typ.)	PF 8670/82
		PGA-socket (68 pins)	PF 8670/33	50 MHz (CLKOUT)	3/4	yes	S/T	Same as above.	None.	PF 8670/83
	TMS 320C30 [16]	PGA-socket (181 pins)	PF 8671/33	35 MHz (xtal)	6/6+	yes	S/T	TMS 320C30	H1: 200 kOhms / 34 pF (typ.) other pins: 200 kOhms / 16 pF (typ.)	PF 8671/83
	TMS 320C31 [1]	QFP-clip (132 pins)	PF 8672/34	35 MHz (X1,X2)	4/5	yes	S/T	TMS 320C31	t.b.d.	
	TMS 320C50/51 [1]	QFT-clip (132 pins)	PF 8673/34	42 MHz (X2, CLKIN)	3/5	yes	S/T	TMS320C50A, TMS320C51A, TMS320C53	t.b.d.	
Motorola	56000/1	PGA-socket (88 pins)	PF 8675/33	30 MHz (Xtal)	3/5	yes	S/T	56000, 56001	None.	PF 8675/83
BUS										
	GPIB/IEEE-488 [14]		PF 8680/36	Max	1/1	yes	S/T		all pins: 200 kOhms / 12 pF (typ.)	
	RS 232C/RS 449 [1]		PF 8682/36	t.b.d.	1/3	yes	S/T		t.b.d.	
	JTAG IEEE 1149.1		PF 8683/36	12.5 MHz (TCK)	1/2	yes	S/T		all signals: >200 kOhms / 40 pF (typ.)	
	I^{2}C/Access Bus [1]	I^{2}C-Bus	PF8681/36	400 kHz	1/1	yes	S/T		all pins: 100 kOhms / 20 pF (typ.)	
	VME-Bus [1]	B-size slot	PF 8684/36	45 MHz	6/6	yes	S/T		all signals: >200 kOhms / 12 pF (typ.) except super selectable signals	
	AT-Bus [1]	Single slot	PF 8686/26	45 MHz	6/6	no	S/T		t.b.d.	
	IBM System 360/370 I/O Bus [1]	Box connector Connector	PF 8685/26	Max	3/3	t.b.d.	S/T		t.b.d.	
	SCSI [2]		ET	Max	2/2	yes	S/T	SCSI-1	Consult supplier	PF 8675/83
Custom Disa Development Software										
	PF 8629/30 [11]	Enables fast, simple generation of disassemblers for microprocessors (up to 32-bit busses) and equivalent applications. (See separate data sheet for details.)								

* Maximum processor frequency available at time of printing or maximum frequency supported by PM 358x logic analyzers and associated processor connection adapter (I.a.), whichever is lower.

** Pods Disa/Full refers to the number of channels required by disassembly only and for full timing analysis.

*** Modes: Adapters can acquire both state and high-speed timing data (S/T), state data and low resolution timing data (S/t), or high-speed timing data only (T).

[1] Consult Philips/Fluke sales office for exact availability.

[2] Available from Emulation Technologies Inc.

[3] Available from Corelis Inc.

[4] Supports only processor versions with multiplexed address/data bus.

[5] Supports only processor versions with non-multiplexed address/data bus.

[6] Burst mode not fully supported.

[7] Access to Boundary Scan Test bus on the processor provided by the adapter.

[8] Conforms to JTAG / IEEE Std. 1149.1.

[9] Does not support 80C196KR - use PF 8729/32 for 80C196KR.

[10] Contact sales office if your specific derivative is not included on this list.

[11] Single-user license. Multi-user PF 8629/31 also available.

[12] Due to pinning differences, cannot be used for 80C515A and 80C535A.

[13] To be used with AMP Micro-Pitch sockets.

[14] Can also support IEC 625 protocol by using the PM 2296/60 accessory (total capacitive load 17 pF (typ.) per pin).

[15] Support includes full set of PF 8603/25 20-40 pin connectors for connection to target.

[16] Adapter contains more than 6 pod connectors of which any 6 can be connected as required.

Warranty – 1 year

Bus Analysis

Convenient, Cost-Saving Bus Analysis

A comprehensive program of bus analysis support facilities for the PM 3580/PM 3585 family logic analyzers enables effective bus analysis without the need for costly, dedicated equipment. This program includes some unique support facilities such as those for IBM's System/360/370 I/O bus and Boundary-Scan Protocol for which no alternatives are at present available on the market.

All logic analyzer bus support packages except for the PF 8682 Serial Data Adapter support the simultaneous state and timing analysis feature of the PM 3580/PM 3585 logic analyzers. This enables all state and timing signals to be captured in a single acquisition, without the need for reconnection or multiple probing of the bus signal lines. This single-probing approach also avoids additional dc and ac loading of the bus signal lines, which could influence the behavior of signals on the bus.

The simultaneous state and timing acquisition capability greatly increases the power and convenience of the logic analysis process. For example, if a bug is suspected in the state list its presence can be revealed immediately simply by switching over to the timing display. With a conventional logic analyzer a separate and additional acquisition run would be needed, with the chance that the bug which is being looked for might not be present - especially if the problem concerned is an intermittent one.

Configuration of the logic analyzer is done automatically by software provided on a distribution disk. This handles pod assignment, label and clock assignments in the Format menu, and updating of the Display menu. After the appropriate setup file has been loaded, the logic analyzer display shows the captured data with the proper signal names.

PF 8680 GPIB/IEEE-488/IEC-625 Bus Analysis Package

The PF 8680 analysis package for the GPIB/IEEE-488 and IEC-625[1] instrumentation buses uses a single adapter connector for timing and state analysis, including disassembly, and makes all the bus signals accessible for capture by the logic analyzer.

PF 8681 I²C-ACCESS.bus Support Package

The bus adapter supplied with the PF 8681 I²C-Bus support package is built in accordance with the I²C-Bus specification as described in the Philips document "The I²C-Bus and how to use it" (January 1992, order no. 9398 393 40011). This support package is also suitable for use with the ACCESS.bus™. One connecting cable for ACCESS.bus support is part of this type number.

One adapter connector is sufficient for full timing and state analysis including disassembly. The two input connectors are connected in parallel. One of these is a type which is frequently used in consumer products containing I²C-Bus components, allowing an easy connection to be made to the adapter. The other input connector is ACCESS.bus compatible.

PF 8682 Serial Data Adapter

The PF 8682 Serial Data Adapter (SDA) package provides versatile facilities for the analysis and troubleshooting of serial data links. A 7- or 8-bit data stream is converted into a series of parallel data blocks. At every complete data block a state clock pulse is generated by the SDA to store the data into the logic analyzer memory during data acquisition. The SDA handles both synchronous and asynchronous simplex, half-duplex and full-duplex data streams. It handles transmitted and received data simultaneously, detects framing and parity errors and automatically detects stop bit(s). Five LED indicators continuously monitor EIA Standard RS-232 and CCITT Standard V.24 interface control lines.

The SDA supports the EIA Standards RS-232C/D/E (CCITT V.24), RS-422A, RS-423A, RS-449 (CCITT V.36) and RS-485. Only the 37-pin connector is supported for the EIA Standard RS-449.

PF 8683 JTAG/IEEE-1149.1 Boundary-Scan Protocol Analysis Package

The PF 8683 package consists of a Boundary-Scan TAP adapter and a Boundary-Scan disassembler. The design of the adapter complies with the JTAG/IEEE-1149.1 Standard Test Access Port and Boundary-Scan architecture. It supports the 5 signals defined in the standard: TCK (Test Clock), TDI (Test Data Input), TDO (Test Data Output), TMS (Test Mode Select) and TRST (Test Reset). The disassembler displays the TAP controller states as defined in the standard (Test-Logic-Reset, Run-Test/Idle, Select-DR-Scan etc.)

The adapter can be connected to the interface cable between a Boundary-Scan tester and the Test Access Port of a board under test. It contains two 10-pin TAP connectors for this purpose.

PF 8684 VMEBus Support Package

The bus adapter supplied with the PF 8684 package is built as a plug-in PCB with two 96-pin (P1 and P2) connectors, and can be inserted directly into a single B-size slot of a double-height subrack. The electrical and mechanical design of the adapter is based on the ANSI/IEEE STD 1014-1987 (IEC-821), and prepared to the IEEE P1014 Rev. D standard, including 64-bit addresses and 64-bit databus support.

The adapter contains four bus grant daisy chains and one interrupt acknowledge daisy chain. All the VMEbus signals are made accessible for capture by the logic analyzer with 6 adapter connections. Six jumpers on the adapter determine which of the signals are connected to the logic analyzer, because 12 signals share 6 logic analyzer channels.

PF 8685 IBM System/360/370 I/O Bus Analyzer Package

The bus adapter supplied with the PF 8685 package is based on specifications from IBM and Hitachi Data Systems (HDS), including the Bidirectional Bus Transfer feature. The adapter may also be used with systems from other manufacturers, providing that they are compatible and meet the required specifications.

Three adapter connections are available for timing and state analysis. All the IBM System/360/370 I/O bus signals, except the BUS 1 signals, are made accessible for capture by the logic analyzer through the 3 adapter connections. The reserved connector pins of the BUS 0 and TAG connector are also routed to the above adapter connections.

After the automatic configuration procedure for the logic analyzer, using the software supplied on the distribution disk, the labels in the Format menu follow the IBM System/360/370 I/O BUS and TAG signal names, except that names are abbreviated to a maximum of 8 characters and state label names may be further abbreviated to get maximum information in the state list.

PF8686PC/AT-Bus Support Package

The bus adapter supplied with the PF 8686 package is built as a plug-in PCB with one 62-pin and one 36-pin edge connector, and can be inserted directly into a single slot of a PC/AT-bus system. The adapter can also be used in a PC/XT-bus system if the main board is free of components under the 36-pin edge connector area.

Six adapter connections are available for timing and state analysis. All the PC/AT- or PC/XT-bus signals present on a standard 98-pin I/O slot are made accessible for capture by the logic analyzer through the 6 adapter connections.

ACCESS.bus is a trademark of DEC

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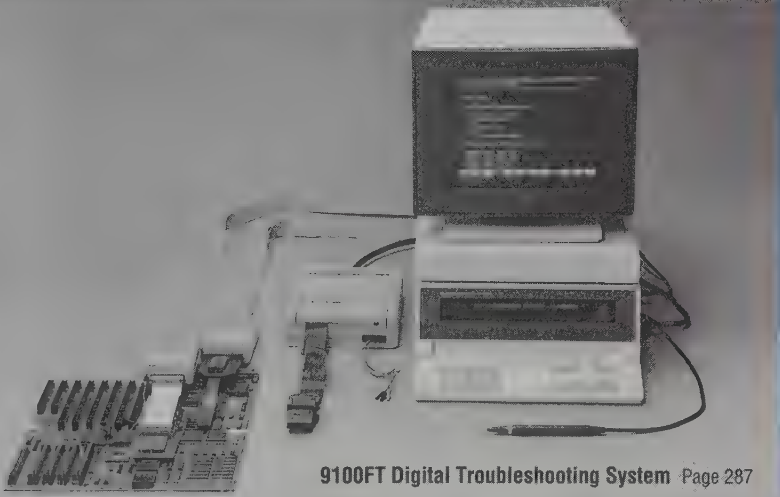
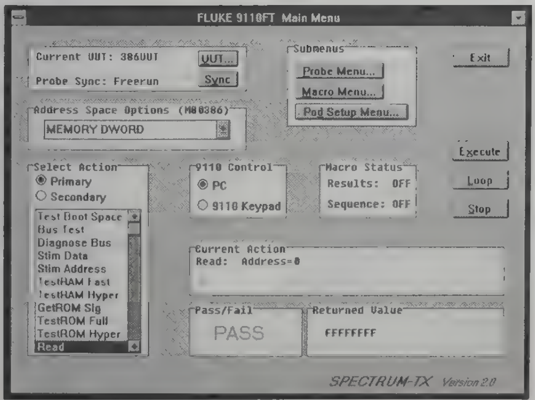
[1] *The separately available PM 2296/60 Bus Adapter is required to connect the GPIB/IEEE-488 adapter to an IEC-625 instrument*

Digital Troubleshooting Tools

9110FT Windows®-Based Digital Troubleshooting System Page 284



9100FT Digital Troubleshooting System Page 287


FLUKE 9110FT Main Menu
UUT...
Sync
Submenus
Probe Menu...
Macro Menu...
Pod Setup Menu...
Exit
Execute
Loop
Stop
Address Space Options (M80386)
Select Action
9110 Control
Macro Status
Current Action
Pass/Fail
Returned Value
Test Boot Space
Bus Test
Diagnose Bus
Stim Data
Stim Address
TestRAM Fast
TestRAM Hyper
GetROM Sig
TestROM Full
TestROM Hyper
Read
SPECTRUM-TX Version 2.0

Current UUT: 386UUT
Probe Sync: Freerun
Address Space Options (M80386): MEMORY DWORD
Select Action: ● Primary ○ Secondary
9110 Control: ● PC ○ 9110 Keypad
Macro Status: Results: OFF Sequence: OFF
Current Action: Read: Address=0
Pass/Fail: PASS
Returned Value: FFFFFFFF

Spectrum-TX Troubleshooting Software for the 9110FT and 9100FT Page 284

With today's rapidly changing technologies, digital and microprocessor-based circuit boards are becoming increasingly difficult to diagnose and repair. Furthermore, labor costs are so high that it is frequently more expensive to repair many circuit boards than to replace them. Fluke offers a complete line of digital troubleshooting tools that provide an alternative to traditional troubleshooting methods. Customers with expensive one-of-a-kind boards use Fluke troubleshooters to pin-point hard to find problems. Repair facilities with high board volumes use Fluke troubleshooters to increase their throughput. And finally, corporations with multiple repair depots frequently gather repair data from one board at the home office and distribute this troubleshooting knowledge throughout their organizations.

Fluke has a variety of troubleshooting solutions to meet your application.

9110FT - a Windows-based troubleshooting solution that requires no programming.

- Built-in tests enable technicians to zero in on general faults up to 30% faster than traditional trouble-shooting tools.
- Supports more than 100 microprocessors with pre-programmed functional tests for the entire microprocessor kernel including RAM test, ROM tests and bus tests.
- Spectrum-TX Troubleshooting software for Windows enables users to select menus and functions by simply pointing and clicking a mouse rather than having to remember keyboard commands.

9100FT - a programmable troubleshooting solution that is very popular in manufacturing repair loops for ATE lines.

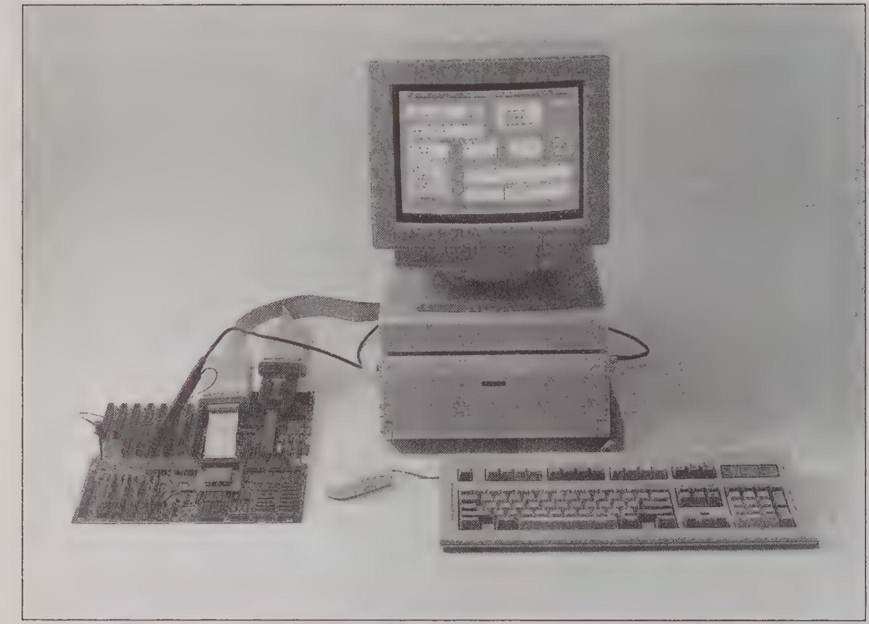
900 - a versatile, economical solution for high-volume service depots or troubleshooting fallout from ATE.

9110FT Digital Troubleshooter Page 284
9100FT Digital Troubleshooter Page 287
9000 Series Micro-System Troubleshooters Page 291
900 Dynamic Troubleshooter Page 293

9110FT

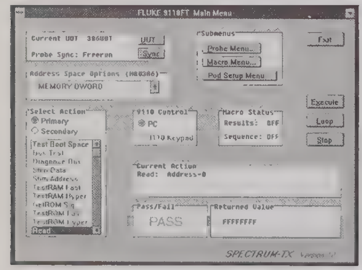
GPIB
IEEE-488

RS-232



9110FT Series Digital Troubleshooter*

- Troubleshoot digital boards faster and easier
- New, Windows-based, Spectrum-TX software
- Built-in tests lets you start troubleshooting right away
- Functional tests and nodal tests pin-point faults



Current UUT 386UUT
Probe Sync: Freerun
Address Space Options (M80386)
MEMORY DWORD
Macro Status
Results: OFF
Sequence: OFF
Current Action
Read: Address-0
Pass/Fail
PASS
Returned Value
FFFFFFFF

Spectrum-TX Troubleshooting Software

Discover the 9110FT

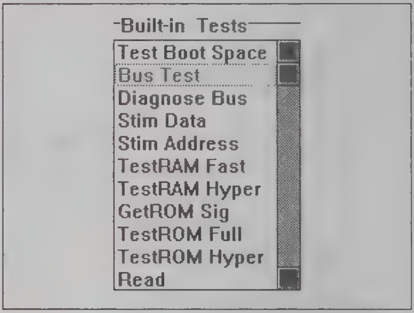
With new Spectrum TX Troubleshooting Software, the 9110FT will save you hours of time and frustration troubleshooting microprocessor-based boards.

Whether it's a dozen boards or a hundred a week, you know how insane it can be – timing problems, no video, boards that won't boot. Repair depots and manufacturing repair lines are realizing that the cost of troubleshooting frequently exceeds the value of the board itself.

Now there's a faster, more economical solution – the Fluke 9110FT Digital Troubleshooter. Just connect the pod to the ROM and microprocessor. Go to the Windows interface. And you can be troubleshooting in minutes. The 9110FT includes built-in tests for RAM, ROM, and the microprocessor bus. Plus, read, write and stimulus routines. The functional tests compare the results from a known good board with those of a suspect board. The node tests let you pin-point the specific fault.

And with our new Windows-based software, troubleshooting is even easier. Spectrum TX for the 9110FT makes it fast and simple. No programming is necessary. Select the tests you want. Run the tests, and store the results in the data files on the PC. This enables you to store test results and transfer them to other 9110FT's in remote locations. This way you can spread your knowledge on one board to depots throughout your organization.

Built-In Tests



Built-in Tests
Test Boot Space
Bus Test
Diagnose Bus
Stim Data
Stim Address
TestRAM Fast
TestRAM Hyper
GetROM Sig
TestROM Full
TestROM Hyper
Read

The 9110FT's built-in tests let you troubleshoot your boards with RAM, ROM and bus tests using comprehensive, pre-written diagnostics. The read, write and stimulus routines let you toggle and ramp the microprocessor, data or address buses.

Bus Test

The bus test checks to see if the microprocessor bus can support program execution by the 9132FT Memory Interface Pod. It controls the unit-under-test's (UUT) microprocessor by sending commands through the ROM sockets. If execution cannot be supported, diagnostic routines are used to help identify which part of the bus (address, data or control lines) is the source of the problem. If the bus can support program execution, the remaining parts of the board can be tested.

RAM & ROM Tests

Fluke's patented HyperRAM and HyperROM tests enable you to test and quickly locate problems in large blocks of memory. The patented Hyper RAM test can test one Megabyte of RAM in as little as one second. The patented Hyper ROM test can test 100K Bytes of ROM in as little as one second. Both HyperTEST algorithms include built-in diagnostics that not only help you find faults in RAM or ROM, but also in the associated address decoding circuitry.

Stimulus Routines

Built-in stimulus routines allow you to stimulate the microprocessor buses by either ramping, rotating or toggling user specified test patterns. No programming is necessary to provide powerful, at speed, stimulus for the entire board.

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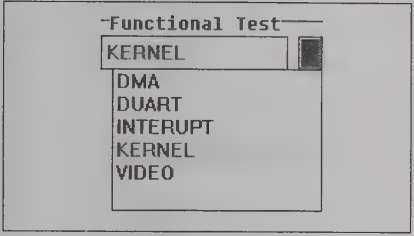
* *The 9110FT Digital Troubleshooting system consists of the 9110FT mainframe, a 9132FT Memory Pod, two ROM modules, single point probe and Spectrum TX Troubleshooting Software which runs on any 386 personal computer with a minimum of 4MB of RAM and a 40 MB hard drive.*

Functional Tests



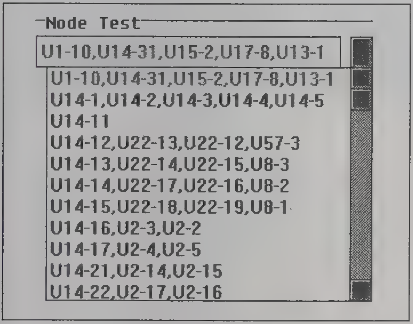
Functional Test

KERNEL

DMA
DUART
INTERUPT
KERNEL
VIDEO

The Functional Test consists of a sequence of built-in tests selected by the user to test a functional block. This test works on a "known good board principle." A known good board is connected to the 9110FT. The various functions are tested, and the results recorded or "learned" by the 9110FT. Later, the results of a suspect board are compared with the results from the known good board to localize a fault. After the initial record or *learn* session, these results can be stored or transferred to other 9110FTs in the field. The 9110FT enables comprehensive, at speed, functional test with no programming. Which is ideal for troubleshooting and repair facilities who repair similar or identical boards repeatedly.

Node Tests



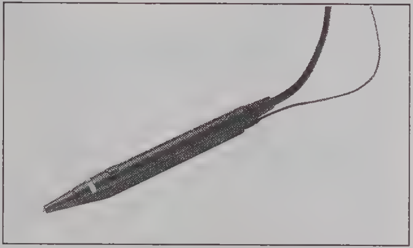
Node Test

U1-10,U14-31,U15-2,U17-8,U13-1

U1-10,U14-31,U15-2,U17-8,U13-1
U14-1,U14-2,U14-3,U14-4,U14-5
U14-11
U14-12,U22-13,U22-12,U57-3
U14-13,U22-14,U22-15,U8-3
U14-14,U22-17,U22-16,U8-2
U14-15,U22-18,U22-19,U8-1
U14-16,U2-3,U2-2
U14-17,U2-4,U2-5
U14-21,U2-14,U2-15
U14-22,U2-17,U2-16

Spectrum's Node Test works using the same known good board concept as Fluke's functional test. Initially, the built-in stimulus routines are used to stimulate the circuits on a known good board. Correct results are generated and recorded from user-selected, critical nodes. During actual troubleshooting, the probe is used to compare the measured result from the suspect board with the recorded result from the known good board. If the results are identical, the node is good. If the results are different, the node test will fail and the operator is informed of the expected result, measured result and stimulus used.

The Probe



The single point probe is used for stimulus routines and node tests. The probe makes level measurements, drives nodes high or low, measures frequency, counts transitions and captures signatures. The probe senses signal level (high, low, or tri-state) based on four standards: TTL, CMOS, ECL or RS-232. The probe measurement can be synchronized to microprocessor bus cycles to capture levels when the address or data is valid.

Memory Emulation Finds Faults at Speed

Based on memory emulation, the 9110FT Troubleshooter is able to diagnose your board at speed from the inside out. The 9110FT is equipped with the 9132FT Memory Interface Pod which replaces the boot ROMs and feeds instruction sequences or test routines to the UUT(Unit Under Test) microprocessor at the boot ROM address space. Instructions are placed in the boot ROM space beginning at the microprocessor reset address. Execution of these instructions will begin when the 9132FT forces a UUT reset. Through these instructions, the 9132FT can instruct the UUT microprocessor to perform the functional, node and built-in tests. As a result, the 9110FT gives you high fault coverage that helps you pinpoint faults in a fraction of the time.

Fluke currently supports more than 90 microprocessors for the 9110FT and is adding new ones on an on-going basis. See the selection charts on pages 325 and 326.

HyperSetup

The HyperSetup option is designed so you can start immediately testing your UUT as soon as you receive your 9110FT or 9100FT Digital Troubleshooter. We furnish all of the necessary setup information and instructions, including setup files on a floppy disk.

As an added feature, HyperSetup also includes verification of the kernel boot portion of your UUT, READ/WRITE operation to I/O space, and RAM tests (RAM initialization not included).

There is a nominal fee for HyperSetup which will be applied toward the purchase of your 9110FT.

Who Should Purchase the 9110FT Digital Troubleshooter?

More than ten thousand Fluke Digital Troubleshooters have been sold worldwide, helping companies reduce their repair costs. Avionics and telecommunications firms are using troubleshooters to pinpoint problems for expensive one-of-a-kind boards. Large corporations have developed standardized test routines for their repair depots. And independent PC repair centers are using digital troubleshooters to diagnose motherboards with limited documentation. The 9110FT can help you solve difficult troubleshooting and repair problems.

Specifications

Technical Specifications

Supplied Software

Description: 9110FT-906 SPECTRUM-TX troubleshooting software, compatible with Microsoft Windows 3.X
Media: 3.5" and 5.25" floppy diskettes, doublesided, high-density

Computer Requirements (Minimum)

25 MHz, 80386-based IBM® or compatible personal computer (Microsoft Windows compatible system with VGA)
4 Mbytes RAM
Hard disk drive with 1.8 Mbytes of free space
National AT-GPIB interface card

Data Timing for Synchronous Measurements

Maximum Frequency: 40 MHz

Minimum Pulse Width (H or L): 12.5 nsec
Minimum Pulse Width (3-state): 20 nsec

Setup Times
Data to Clk: 5 nsec
Start, Stop or Enable to Clk: 10 nsec

Hold Time
Clk to Enable: 10 nsec
Clk to Start or Stop: 0 nsec

Data Timing for Asynchronous Measurements

Maximum Frequency: 40 MHz
Minimum Pulse Width (H or L): 12.5 nsec

Minimum Pulse Width-Invalid (X)
TTL or CMOS: 100 nsec ± 20 nsec
RS-232C: 2000 nsec ± 400 nsec

Maximum Count: 16777216 + overflow

Transition Counting

Maximum Frequency: 40 MHz minimum
Maximum Count: 16777216 + overflow
Maximum Stop Count: 65536 clocks

9110FT

Frequency Measurement

Maximum Frequency: 40 MHz minimum
Resolution: 20 Hz
Accuracy: ±250 ppm ±20 Hz

Output Pulser

High: >3.5V @ 200 mA for less than 10 sec @ 1% duty cycle; >4.0V @5 mA continuously
Low: <0.8V @ 200 mA for less than 10 sec @ 1% duty cycle; <0.4V @ 5 mA continuously

Clock Module Specifications

Input Threshold: 1.6V ±0.2V
Input Impedance: 50K shunted by less than 10 pF

Clock, Start, Stop, and Enable Input Speed

Maximum Repetition Rate: 40 MHz
Minimum Pulse Width: 12.5 nsec

RS-232C Interfaces

One isolated (system referenced)
One non-isolated (earth referenced)
Baud Rates: 110, 134, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200

Electrical Specifications of Probe

Input Thresholds

TTL	CMOS	RS-232C	ECL	
5.0V	5.0V	30.0V	30.00V	Guaranteed HIGH
2.6V	3.7V	3.2V	-1.15V	High or invalid
2.2V	3.3V	2.8V	-1.35V	Guaranteed invalid
1.0V	1.2V	-2.8V	-1.35V	Low or invalid
0.6V	0.8V	-3.2V	-1.55V	Guaranteed LOW
0.0V	0.0V	-30.0V	-30.00V	

Input Impedance: 70Ω shunted by less than 33 pF

Parity: Odd, even, or none
Data Bits: 5, 6, 7, or 8
Stop Bits: 1, 1.5, 2
XON/XOFF (Ctrl-S/Ctrl-Q): Disable/enable
Clear to Send: Disable/enable
New Line: Carriage Return/Line Feed or Carriage Return

General Specifications

Operating Temperature: 5°C to 27°C; 95% RH maximum (non-condensing); 27°C to 40°C; RH decreasing linearly from 95% to 50% (non-condensing)
Storage and Shipping: -20°C to 60°C; 8% to 80% RH non-condensing. Micro-floppy media limited to 5°C to 60°C, 8 to 80% RH non-condensing.
Line Voltage: 90 to 132 VAC; 47 Hz to 440 Hz, 180 to 264 VAC; 47 Hz to 63 Hz
Power Consumption: 150 watts maximum
Safety: Designed to meet the following safety standards: ANSI/UL 478, IEC 348, IEC 435, and CSA 556B
Size: 14.0 cm H x 34.3 cm W x 50.8 cm D (5.5 in H x 13.5 in W x 20.0 in D)
Weight: 8.26 kg (18.2 lb)

Ordering Information

Mainframes

9110FT Digital Troubleshooter
System components include:
- 9110FT Mainframe
- One 40 MB Hard Disk Drive
- One Micro-Floppy Disk Drive
- IEEE-488 Interface
- 4 Mbytes of RAM
- Real-Time Clock
- Two RS-232C Communication Port
- 9110FT-906 SPECTRUM-TX Troubleshooting Software
- Manual Set

9110FT/PKG32 Digital Troubleshooting Package. System components include:
- 9110FT Digital Troubleshooter*
- 9132FT Memory Interface Pod
- Two-9132FT-ROM Universal ROM Module
- Two-9132FT-DIP32 24/28/32 Pin ROM Module Adapters

** See description above*

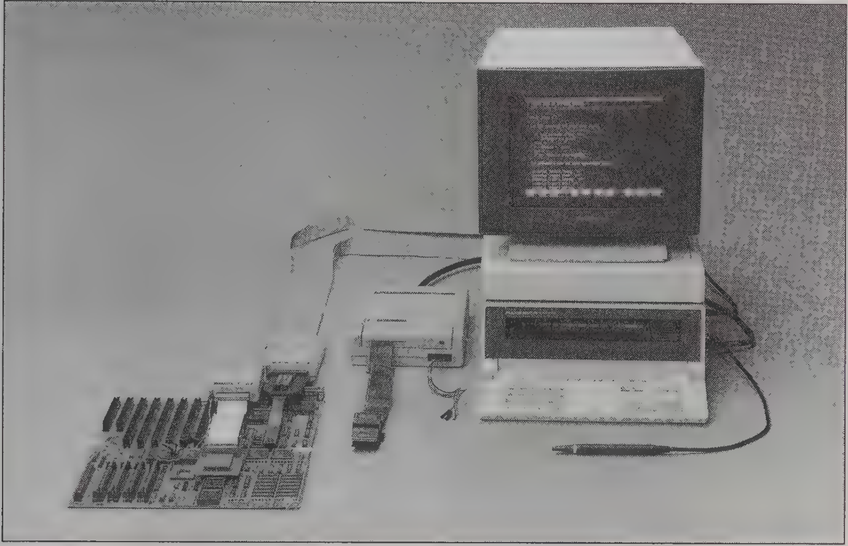
Options

9110FT-906 SPECTRUM-TX Troubleshooting Software
SM7710B National AT GPIB Interface Card
SM7714B Microsoft Serial Mouse
SM8620B Microsoft Windows 3.0 (5.25" Disks)
SM8620C Microsoft Windows 3.0 (3.5" Disks)
Y8021 Shielded IEEE-488 Cable (1m)
Y8022 Shielded IEEE-488 Cable (2m)
Y8023 Shielded IEEE-488 Cable (4m)

9100FT Series

GPIB
IEEE-488

RS-232



9100FT Series Troubleshooting Test Systems

- Isolates digital faults quickly
- Interfaces with over 90 different 8- to 32-bit microprocessors
- Built-in functional tests and diagnostics for RAM, ROM, and the microprocessor bus
- Immediate mode troubleshooting with a PC using Spectrum-TX (9100/9110)
- Automates your troubleshooting process (9100/9105)

Dramatically Reduce Board Troubleshooting and Repair Costs with Fluke's 9100 Series. It's an Easy Economical Way to Pinpoint Faults on Microprocessor-Based Boards.

The 9100FT Series includes Fluke's top of the line digital troubleshooters. They are designed to functionally test and quickly isolate faults in digital circuits. Nothing compares to the 9100FT Troubleshooting Test System for exceptional value. The 9100FT Series consists of the 9100FT, 9105FT, and the 9110FT, each designed to fulfill varying requirements. Select the appropriate system based on your test and troubleshooting needs.

The 9100FT can be programmed to automate the troubleshooting process. In manufacturing, it can be used to troubleshoot circuit boards off-line, without tying up your functional tester with the task of isolating board faults. For service, the 9100FT can automate some of the troubleshooting tasks and thereby reduce fault isolation times. The 9105FT is designed to be a lower cost execute-only system for programs created on a 9100FT.

The 9110FT has been specifically designed to provide "immediate mode" troubleshooting through an easy to use PC interface. All troubleshooting functions and tests are selected from a menu using the mouse on the PC. As each action is selected, the PC passes the appropriate commands to the 9110FT and then displays any resulting information on the PC screen. See the 9110FT section for detailed information.

Any of the 9100FT Series products enables technicians to isolate tough-to-find board faults in short order. So you can correct the fault, avoid rejecting the board, provide timely fault information to your quality program, and save money in the process. In fact, a new 9100FT Series system can pay for itself in a matter of months.

The 9100FT Series products can test UUTs with processor clock speeds up to 50 MHz, making them ideal for boards incorporating the latest high-speed RISC, CISC, and DSP processors. For economy, performance, and ease of use, 9100FT systems are the best no-fault insurance that money can buy.

Emulation is the Key to "Kernel-Busting"

The 9100FT Series uses emulative testing, which is the quickest, most dependable method for finding faults in kernel circuitry. Emulative testing - a technique pioneered by Fluke - derives its name from the way the system emulates the microprocessor on the unit-under-test (UUT) to give you a "real-world" perspective of how your boards will perform during operation.

To speed up the testing process and give you the ultimate in flexibility, the 9100FT mainframe contains its own preprogrammed tests with built-in diagnostics that exercise the UUT kernel. These routines include tests for RAM, ROM, and the microprocessor bus. Simply call out the address of RAM and ROM, and tie the appropriate pod into the microprocessor circuitry of the UUT. Then you're off and testing your UUT without having to write a single line of program code.

The 9100FT Series uses two different methods of interfacing with the microprocessor kernel: memory emulation and microprocessor emulation. Either of the two methods gives you complete control of the UUT's bus. Between them, the 9100FT is able to provide comprehensive fault isolation and troubleshooting on boards based on over 90 microprocessors. For a detailed description of the features of the microprocessor emulators and the microprocessors they cover call 1-800-44-FLUKE and request a copy of the 9100FT Series Emulation Selection Guide.

Three Levels of Troubleshooting

The 9100 Series offers three levels of operator interface to match different levels of expertise: Immediate Mode, User-Guided Fault Isolation (UFI), and Guided Fault Isolation (GFI). If you are proficient in troubleshooting digital circuits you can use Immediate Mode to isolate faulty components without writing any code. You can run all preprogrammed tests and exercise every stimulus and measurement function of the 9100FT from the front panel. You decide where to probe and whether the UUT's responses are correct. The Immediate Mode lets you begin using any of the 9100FT Series Test Systems to troubleshoot faulty boards the first day you get it.

Utilizing Fluke's new Spectrum-TX software package on an IBM compatible PC, a technician can isolate faulty components within digital circuitry quickly and easily. Spectrum-TX software takes full advantage of Microsoft's Windows user interface for selecting and performing test and troubleshooting routines on a UUT. Technicians simply point and click to select menus and functions so they spend time testing boards, instead of testing their memories with arcane keyboard commands. Once a technician selects a command and enters the appropriate variables, Spectrum-TX automatically constructs the commands and sends the information to the 9110FT via the IEEE-488 bus. There the command is interpreted and converted into the appropriate action. When complete, the 9110FT mainframe will then return a response to the PC indicating the results of the command and, if necessary, signal the PC that results are available for display on the monitor. This is an immediate mode operation, requiring the operator to decide where to probe, what commands to use and what each response means in the troubleshooting process.

Fluke's Spectrum-TX Troubleshooting Software gives technicians greater control in other ways too. Because it allows users to capture, store, and print response data gathered by the 9110FT. All at the touch of a mouse or trackball button.

The next level of automation is User-Guided Fault Isolation (UFI). In this case, you use the 9100FT to run the stimulus programs for a node, and display information on whether the node is good or bad. This semi-automated mode enables you to determine which nodes to test, but the execution of the stimulus routines and determination of a correct response are fully automated.

The highest possible level of automated troubleshooting on the 9100FT is Guided Fault Isolation (GFI). It uses the 9100FT's three-line display to guide users to probe specific nodes without requiring them to judge a node's performance. GFI enables those who are inexperienced in troubleshooting and unfamiliar with the UUT to efficiently and effectively track down faulty components in the UUT.

Analog and Digital Capability

The 9100FT incorporates a GPIB/IEEE-488* interface enabling you to use both analog and digital measurements to isolate board faults. Utilizing the IEEE-488 port, your 9100FT can "talk" to other instruments and controllers. This gives you the ability to control and retrieve information from external test equipment.

The Right Tester for the Right Job

Since it's designed to isolate tough-to-find faults in kernel circuitry, the 9100FT is the most appropriate system for troubleshooting boards that fail in-line functional testing.

Because the 9100FT is designed for three levels of operator interface, it allows you to tailor the system to operators' skill levels. This gives you a solid, dependable way to ensure that rejected boards get repaired quickly and economically, and are given a fast functional test before going back onto the manufacturing line.

What's more, you won't be saddled with a backlog of boards awaiting troubleshooting. And the 9100FT is a value choice - you'll be seeing bottom-line results in no time.

HyperSetup

The HyperSetup option is designed so you can start immediately testing your UUT as soon as you receive your 9110FT or 9100FT Digital Troubleshooter. We furnish all of the necessary setup information and instructions, including setup files on a floppy disk.

As an added feature, HyperSetup also includes verification of the kernel boot portion of your UUT, READ/WRITE operation to I/O space, and RAM tests (RAM initialization not included).

There is a nominal fee for HyperSetup which will be applied toward the purchase of your 9100FT.

Put Fluke's 9100FT to the Test Today.

For detailed information on the 9100FT Series call 1-800-44-FLUKE and ask for a copy of the 9100FT or 9110FT Technical Data Sheet, or contact your local Fluke sales representative.

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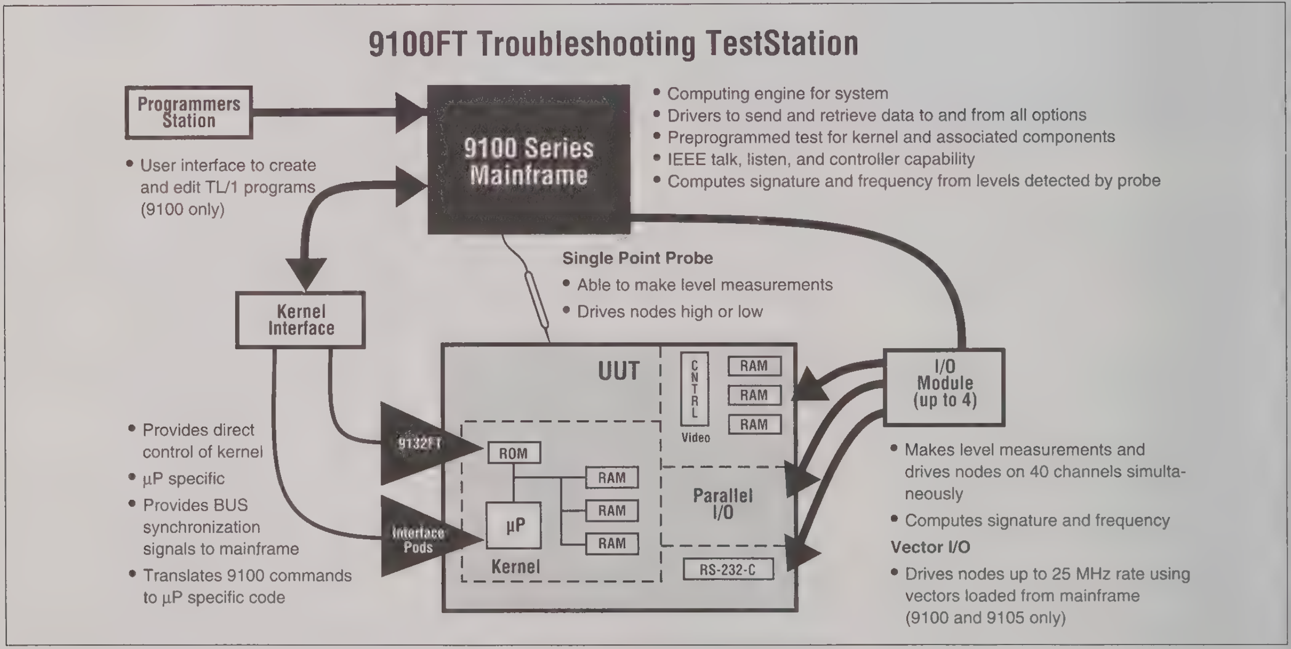
* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*



9100FT Troubleshooting TestStation

- Computing engine for system
- Drivers to send and retrieve data to and from all options
- Preprogrammed test for kernel and associated components
- IEEE talk, listen, and controller capability
- Computes signature and frequency from levels detected by probe

- User interface to create and edit TL/1 programs (9100 only)

Single Point Probe
- Able to make level measurements
- Drives nodes high or low

- Provides direct control of kernel
- µP specific
- Provides BUS synchronization signals to mainframe
- Translates 9100 commands to µP specific code

- Makes level measurements and drives nodes on 40 channels simultaneously
- Computes signature and frequency

Vector I/O
- Drives nodes up to 25 MHz rate using vectors loaded from mainframe (9100 and 9105 only)

Specifications

Technical Specifications

Electrical Specifications of Probe

Input Thresholds

TTL	CMOS	RS-232C	ECL	
5.0V	5.0V	30.0V	30.00V	Guaranteed HIGH
2.6V	3.7V	3.2V	-1.15V	High or invalid
2.2V	3.3V	2.8V	-1.35V	Guaranteed invalid
1.0V	1.2V	-2.8V	-1.35V	Low or invalid
0.6V	0.8V	-3.2V	-1.55V	Guaranteed LOW
0.0V	0.0V	-30.0V	-30.00V	

Input Impedance: 70 kΩ shunted by less than 33 pF

Data Timing for Synchronous Measurements

Maximum Frequency: 40 MHz
Minimum Pulse Width (H or L): 12.5 nsec
Minimum Pulse Width (3-state): 20 nsec

Setup Times
Data to Clk: 5 nsec
Start, Stop or Enable to Clk: 10 nsec

Hold Time
Clk to Enable: 10 nsec
Clk to Start or Stop: 0 nsec

Data Timing for Asynchronous Measurements

Maximum Frequency: 40 MHz
Minimum Pulse Width (H or L): 12.5 nsec

Minimum Pulse Width-Invalid (X)
TTL of CMOS: 100 nsec ±20 nsec
RS-232: 2000 nsec ±400 nsec
Maximum Count: 16777216 + overflow

Transition Counting

Maximum Frequency: 40 MHz minimum
Maximum Count: 16777216 + overflow
Maximum Stop Count: 65536 clocks

Frequency Measurement

Maximum Frequency: 40 MHz minimum
Resolution: 20 Hz
Accuracy: ±250 ppm ±20 HZ

Output Pulser

High: >3.5V @ 200mA for less than 10 µsec @ 1% duty cycle. >4.0V @ 5mA continuously
Low: <0.8V @ 200mA for less than 10 µsec @ 1% duty cycle. <0.4V @ 5mA continuously

Clock Module Specifications

Input Threshold: 1.6V ±0.2V
Input Impedance: 50 kΩ shunted by less than 10 pF

Clock, Start, Stop, and Enable Input Speed

Maximum Repetition Rate: 40 MHz
Minimum Pulse Width: 12.5 nsec

RS-232 Interfaces

One isolated (system referenced)
One non-isolated (earth referenced)
Baud Rates: 110, 134, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200
Parity: Odd, even, or none
Data Bits: 5,6,7, or 8
Stop Bits: 1, 1.5, 2
XON/XOFF (Ctrl-S/Ctrl-Q): Disable/enable
Clear to Send: Disable/enable
New Line: Carriage Return/Line Feed or Carriage Return

General Specifications

Operating Temperature: 5°C to 27°C; 95% RH maximum (non-condensing). 27°C to 40°C; RH decreasing linearly from 95% to 50% (non-condensing).
Storage/Shipping: -20°C to 60°C; 8% to 80% RH non-condensing. Micro-floppy media limited to 5°C to 60°C, 8 to 80% RH non-condensing.
Line Voltage: 90V to 132V AC; 47 Hz to 440 Hz. 180V to 264V AC; 47 Hz to 63 Hz

Power Consumption
Mainframe: 150 watts maximum
Monitor: 50 watts maximum

Size
Mainframe: 14.0 cm H x 34.3 cm W x 50.8 cm D (5.5 in H x 13.5 in W x 20.0 in D)
Monitor: 30.5 cm H x 33.5 cm W x 33.0 cm D (12.02 in H x 13.2 in W x 13.00 in D)
ASCII Keyboard: 5.02 cm H x 21.15 cm W x 47.2 cm D (2.0 in H x 8.33 in W x 18.51 in D)

Weight
Mainframe: 8.26 kg (18.2 lb)
Monitor: 8.44 kg (18.6 lb)
ASCII Keyboard: 1.59 kg (3.5 lb)

Safety

Designed to meet the following safety standards: ANSI/UL 478, IEC 348, IEC435, and CSA 556B.

Ordering Information

Mainframes

9100FT/SYS Digital Test and Programming System. System components include:
- 9100FT Digital Test System
- 9100FT-004 Programmer's Station
- 9100A-003 Parallel I/O Module (1)
- Y9100A-DCS DIP Clip Set
- 9 Days of Training

These components are available separately and are described in more detail below.

9100FT Digital Test System. System components include:
- 9100FT Mainframe
- One 40 MB Hard Disk Drive
- One Micro-Floppy Disk Drive
- IEEE-488 Interface
- 4 Mbytes of RAM
- Real-Time Clock
- Two RS-232 Communication Ports
- Y8091 Micro-Floppy Disks (10)
- Manual Set

9105FT Digital Test System. System components include:
- 9105FT Mainframe
- Two Micro-Floppy Disk Drives
- IEEE-488 Interface
- 4 Mbytes of RAM
- Real-time Clock
- Two RS-232 Communication Ports
- Y8091 Micro-Floppy Disks (10)
- Manual Set

Options (9100FT Only)

9100FT-004 Programmer's Station. System components include:
- Programmer's System Software Disk
- Monochrome Monitor
- Programmer's Manual
- Programmer's Keyboard
- Video Card (monochrome)

9100FT-005 Programmer's Station, Color Option The 9100FT-005 is like the 9100FT-004, but it includes an IBM CGA-compatible color video card. The user must supply a color monitor.

9100A-020 9100A Test Language Checker. This system requires an IBM PC, PC-XT, PC-AT, or compatible with 512 KB memory and MS-DOS 3.0 or later. System components include:
- One 5-1/4" and one 3-1/2" disk
- User's manual
- Y1709 Null Modem Cable

9100A-030 9010A to 9100FT Program Translator. This software package translate existing 9010A programs into 9100FT TL/1 programs. 9010A programs are transferred via an RS-232 interface to the 9100FT, where the translator creates a TL/1 program.

9100FT Series

Options (9100FT & 9105FT Only)

9100A-003 Parallel I/O Module. Provides 40 channels of overdrive stimulus and signature, level, count, or frequency measurement. Up to 4 I/O modules can be connected to a 9100FT or 9105FT at a time.

9100A-009 Video, Monochrome. For situations in which information must be displayed through a CRT, the 9100A-009 can be added to a non-programmable 9100FT or 9105FT Test Station. Components include:
Video Card with Cable
Monochrome Monitor

9100A-011 Video Card, Color. The 9100A-001 allows a 9100FT or 9105FT Test Station to display information on a color monitor. It includes an IBM CGA-compatible color video card. The user must supply a color monitor.

9100A-014 Provides 4 Mbytes of additional memory to 9100FT and 9105FT mainframes.

9100A-017 Vector Output I/O Module. Provides 40 channels of output vector stimulus and signature, level, count, and frequency measurement. Up to 4 I/O modules can be connected to a 9100FT or 9105FT at a time.

Accessories (Also see Section 19)

Y8021 1-Meter Shielded IEEE-488 Cable
Y8022 2-Meter Shielded IEEE-488 Cable
Y8023 4-Meter Shielded IEEE-488 Cable
Y8091 3.5 inch Micro-Floppy Diskettes (10)
Y8092* 3.5 inch High-Density (1.2 MB) Micro-Floppy Diskettes (10)
Y9100A-14D DIP Clip Module, 14-Pin
Y9100A-16D DIP Clip Module, 16-Pin
Y9100A-18D DIP Clip Module, 18-Pin
Y9100A-20D DIP Clip Module, 20-Pin
Y9100A-24D DIP Clip Module, 24-Pin
Y9100A-28D DIP Clip Module, 28-Pin
Y9100A-40D DIP Clip Module, 40-Pin
Y9100A-DCS DIP Clip Set (one of each DIP clip)
Y9100A-20L Flying-Lead Set, 20 Leads, includes packet of 25 clips
9100A-14S Small-Outline Clip Module, 14-Pin
Y9100A-16S Small-Outline Clip Module, 16-Pin
Y9100A-20S Small-Outline Clip Module, 20-Pin
Y9100A-24S Small-Outline Clip Module, 24-Pin
Y9100A-28S Small-Outline Clip Module, 28-Pin

Y9100A-100 Card Edge Fixture Kit: Enables the user to create a UUT-specific card edge fixture for the 9100FT and 9105FT. It includes a comprehensive manual, a performance circuit board, and a sheet metal housing. One to four card edge interface modules (Y9100A-102) are required.

Y9100A-101 Card Edge Fixture Base. Allows the user to base-mount a Card Edge Fixture Kit (Y9100A-100). It consists of a nonconductive work surface and a 15 3/4" x 19" x 3" sheet metal enclosure for a power supply, fan, pod, and other components.

Y9100A-102 Card Edge Interface Module. This module is designed to plug into the Card Edge Fixture Kit (Y9100A-100) at one end and into a Parallel I/O Module at the other, connecting all 40 pins of the I/O Module to the card edge connector. One interface module is required for each I/O Module, and up to four interface modules can be used with one fixture.

Y9100A-7201 Probe Accessory Kit. This kit provides commonly needed replacement parts for probes. The kit includes:
5 Probe Tips
1 Probe Tip Cable Assembly
1 Ground Clip Hook (large)
1 Ground Cable Assembly
8 Clock Module Clips (small)

Y9100A-7203 Footswitch, for triggering the 9100FT or 9105FT

**Not recommended for use with low-density drives.*

Manuals

Getting Started Guide
Automated Operations Manual
Technical User's Manual
Applications Manual
TL/1 Reference Manual
Supplemental Pod Information Manual
Programmer's Manual

Customer Support Services

Also see Section 20.

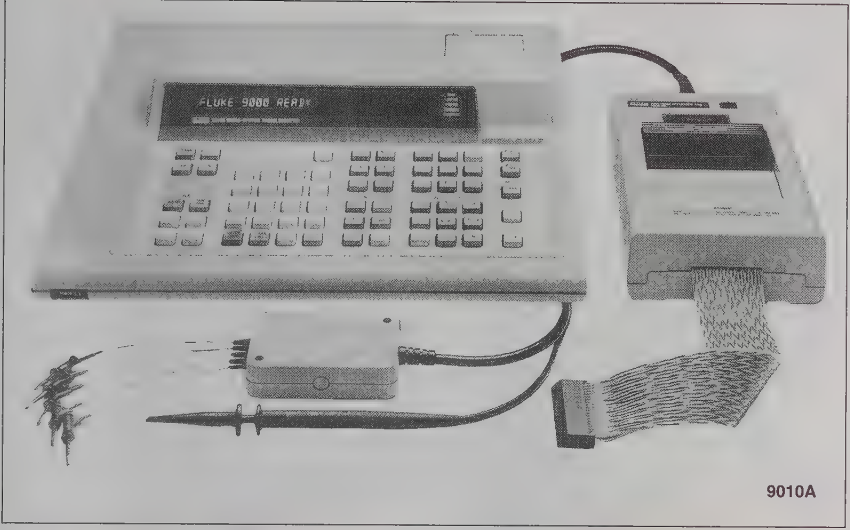
Factory Warranty

One-year product warranty.

9000 Series

GPIB IEEE-488

RS-232



9010A

9000 Series Micro-System Troubleshooters

- Troubleshoot microprocessor-based boards with ease
- Microprocessor Interface Pods for over 50 microprocessors
- Perform BUS, ROM and RAM testing with a few key strokes
- Write test programs in a language independent of the µP
- FREE troubleshooting course with purchase

Troubleshoot your Microprocessor-Based Boards

Troubleshoot microprocessor-based boards or assemblies by controlling the stimulus for the test and by synchronizing the timing of the measurement to the stimulus. This control and synchronization make the Fluke 9000 Series Micro-System Troubleshooter a very powerful instrument you can use to locate defects on microprocessor-based boards.

Built-in Tests for the Kernel

The 9000 Series uses microprocessor emulation – a technique pioneered by Fluke. The tester takes control of the microprocessor bus of the unit under test (UUT) and gives you full control of the UUT. Simply plug the appropriate Microprocessor Interface Pod into the microprocessor socket on the UUT. (A complete list of interface pods is available in the *9100FT Emulation Selection Guide.*) Built-in preprogrammed test algorithms are invoked with a few key strokes. These routines allow you to verify proper operation of the microprocessor bus circuitry to catch such failures as "stuck" bus lines or lines tied together as well as defective components. The bus circuitry includes all address and data lines as well as microprocessor status and control lines. In addition, the ROM Test verifies that all ROM locations are read properly; the RAM Test verifies that read and write access of the RAM memory functions properly. These tests are executed at the normal operating speed of the processor on the UUT to ensure full fault coverage of all dynamic or timing failures.

Troubleshooting Functions

The 9000 Series supports a number of generic troubleshooting commands that are independent of the microprocessor's assembly language. The WRITE command allows you to set-up or initialize memory, control or data registers, while the READ command gives you a very simple mechanism to verify the response or the content of a memory location or I/O register. Special commands (like the RAMP, WALK, DATA LINE TOGGLE) allow you to create the desired stimulus with a couple of key strokes.

The 9000 Series supports a troubleshooting probe that you can use either to monitor the logic activity on a node or to inject stimulus pulses. The probe measurement or stimulus can be synchronized to the processor activity. The probe automatically performs three measurements at each node probed: (1) the detection of logic levels (High, Low, and Tri-state), (2) transition counts, and (3) 16-bit Cyclic Redundancy Check (CRC) signatures.

A stimulus operation can be repeated in a "Loop" which allows the technician to probe along the signal path to locate or pinpoint the problem node.

Three Models

The 9000 Series supports three models: the 9010A, the 9005A and the 9020A. The three troubleshooters differ primarily in their programming capability and system integration capability.

The **9010A** is a self-contained, stand-alone, programmable unit. It lets you troubleshoot the UUT in a key stroke or immediate mode of operation. You can invoke all of the pre-programmed tests as well as the many troubleshooting commands with one or just a few key strokes. Furthermore, the 9010A lets you create or edit test routines in a key stroke programming mode. These test routines can be saved on a mini-cassette, or if the unit is equipped with the optional RS-232C interface, these test routines may also be uploaded to a computer.

The non-programmable **9005A** offers the same immediate mode operation as the 9010A but you cannot generate new test routines from the keyboard. The 9005A can execute test routines read from a mini-cassette tape. If the unit is equipped with the optional RS-232C interface, test routines may be downloaded from a computer.

The **9020A**, designed for use in a system, executes test instructions stored in a test program in a system controller or computer. The 9020A is controlled via an IEEE-488 interface or an RS-232C interface. It does not have programming keys or a mini-cassette drive.

The 9000 Series can be used for troubleshooting up to 16-bit microprocessors. To troubleshoot up to 32-bit processors, see the 9100FT Series in this catalog section.

Specifications

General Specifications

Temperature: 0°C to +50°C operating temperature (+10°C to +40°C for mini-cassette); -40°C to +70°C non-operating temperature (+4°C to +50°C for mini-cassette)

Power: 100, 120, 220, 240V ac ±10%; 50 Hz, 60 Hz ±5%; 40W maximum

Size: 11.5 cm H x 35.5 cm W x 30.5 cm D (4.5 in H x 14 in W x 12 in D)

Weight: 6 kg (13 lb) mainframe; 0.7 kg (1.5 lb) per interface pod

9000 Series

Ordering Information

Models

9005A Micro-System Troubleshooter
9010A Micro-System Troubleshooter with Program Function
9020A-001* Micro-System Troubleshooter with RS-232C Interface
9020A-002* Micro-System Troubleshooter with IEEE-488 Interface

** A 9020A without interface is not available*

Options* (for 9010A and 9005A)
9010A-001 RS-232C Interface
9000A-910 Utility Program Tape
9010A-920 Language Compiler, 1722A Instrument Controller
9010A-923 Language Compiler for IBM Personal Computer
9100A-030 A program that converts 9010A programs to TL/1, which can be executed on a 9100A or 9105A

Options* (for 9010A, 9005A and 9020A)
9000A-006 Asynchronous Signature Probe

** Factory configured or Service Center installable only*

Accessories (Also see Section 19)
9000A-200 Pod Adapter Packaging Kit
9000A-900 Transit Case
Y8007 Ten-Pack of Mini-Cassettes

Manuals*
9005A Operator
9005A Service
9010A Operator
9010A Programming
9010A Reference Care
9010A Service
9020A Getting Started
9020A Operator
9020A Reference Card
9020A Service

** No charge with purchase of unit*

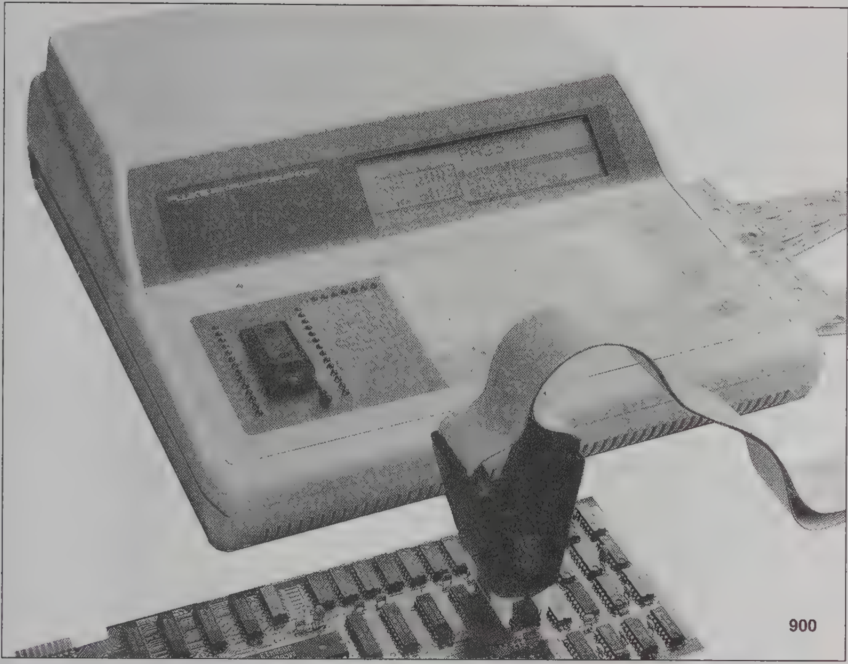
Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

900

RS-232



900

900 Dynamic Troubleshooter
Tests IC at speed while operating in the circuit
Supports standard and custom devices
No test programs required
Detects intermittent and timing faults
Softkey menu for easy operation
Includes a self-paced tutorial

Troubleshoot Problem Circuits to the Component Level. Quickly and Accurately.

The 900 is a powerful measurement and analysis tool that helps a technician isolate faults in digital circuits fast and accurately. It complements any stimulus source, such as hot mockup or functional test. The 900 is used to isolate faults down to the defective component. By accurately isolating faults to a specific chip, you'll put an end to shot-gun repairs. Instead of replacing a whole group of parts, you replace only the failed part. You'll save time and money, and minimize the risk of damaging multi-layer circuit boards.

Even the Toughest Problems

The Fluke 900 uses a unique reference comparison technology that allows digital ICs to be tested at operating speed, while still in circuit. The 900 detects static faults, timing faults, and even intermittent faults. It also isolates faulty components on a bus or in a feedback loop.

The 900 does not back-drive the device under test (DUT) or guard points, nor does it force any artificial signals into the unit under test (UUT). Rather, it passively monitors the DUT while operating, and compares the DUT's behavior with that of a known good part. You need only generate some logic activity on the board. And that's easy with an emulative tester, such as the Fluke 9100FT or 9010A. Or drive the board with a hot mock-up. Even the board's own self-test routine is sufficient.

The reference comparison technique makes the 900 effective on almost all digital ICs. RAM, EPROMs, and components with tri-state and bidirectional leads can be easily tested. Even proprietary ICs like PALs – usually a testing nightmare – can be tested quickly.

Reference Device Simulation

The reference comparison technique takes advantage of the replacement parts you already have on hand. However, since maintaining a large stockpile of chips is inconvenient, many of the common TTL and CMOS chips are *simulated.* Reference device simulation removes the need to maintain, handle, and insert a reference device. This saves troubleshooting time.

Simulation is implemented using a reconfigurable high speed logic array which is programmed from a "Simulation Library" to behave like the DUT. The Simulation Library is distributed on floppy disks compatible with the MS-DOS operating system. The library distribution disk contains the utility programs and routines to allow the user to select and configure a simulation library for a specific UUT. A Simulation Library Maintenance Agreement is included for the first year after purchase of the Fluke 900, and is renewable thereafter.

Test Sequences, Not Test Software

There's no need to write device timing descriptions or comprehensive test programs. But you do have the option of developing test sequences for your workload. A test sequence lists the order in which to test ICs on a particular board, along with the test and setup parameters for each device. Developing a test sequence is simple: it requires checking each IC on a good board and storing the test and setup parameters for each IC. In fact, the "Learn" feature will even recommend test parameters. Along with the test parameters, operator prompts may be stored as well. Once a test sequence is available, your junior technicians can troubleshoot like a pro. Experienced technicians are still free to use their intuition. To test the suspect IC in a circuit, type in the reference designator, clip, and press TEST. Test sequences can be saved in non-volatile memory cartridges, or downloaded from a PC over the RS-232C interface.

The 900 PC Software

As an alternative to developing and running your test sequences from the stand-alone Fluke 900, the 900 may also be fully controlled from a PC over the RS-232C interface. With the 900 PC Software package, a user has access to the full range of 900 capabilities from the PC. Pull-down menus and pop-up windows help the user become productive quickly, without having to spend extra time learning how to operate the 900. This software package is especially useful when generating a test sequence. A test sequence developed using the 900 PC Software can very simply be downloaded for stand-alone execution on the Fluke 900.

900

Specifications

General Specifications

Power: 115/230V ac, 47 Hz to 63 Hz, 100W
Storage Temperature: -40°C to +70°C
Operating Temperature: 0 to +50°C
Electronic Parameters:

- Devices supported: digital components up to 28 pins, SSI to VLSI capable of driving one LS load
  - N, S, F, LS, AS, ALS, HC, HCT, ACT, FACT, Open Collector TTL, TTL compatible CMOS
  - Custom components: PAL, HAL, PLA, FPLA, and Gate Arrays
  - Memory: static & dynamic RAM, ROM, PROM, EPROM, FIFO
- Fault detection adjustable from 20 nsec to 200 nsec, in 10 nsec increments
- DUT tested at data rate of up to 20 MHz (i.e. bandwidth on each DUT connection is 20 MHz)
- Minimum pulse width: 20 nsec
- Minimum slew rate: 10V/µsec
- Pin loading on UUT: 10 KΩ @ 30 pf
- DUT input connections protected to ±25V
- Device logic levels: programmable 0 to 5V, in 100 mV steps, with ±100 mV accuracy
- Device Test Time programmable from 1 to 9990 msec, or continuous; synchronization & utilization times from 10 to 9990 msec
- Elapsed time-to-fault reading has 40 nsec resolution; minimum interval measured is 40 nsec
- Trigger Circuit: user-specifiable, two words of 28 pins on the DUT plus 1 external node
- Gate Circuit: user-specifiable, one word of 28 pins on the DUT plus 1 external node
- Frequency counter measurement to 25 MHz, <.5% 20 nsec minimum pulse width

Size

Main Unit: 30.5 cm H x 38.1 cm W x 1.9 cm D (12 in H x 15 in W x 3.5 in D)
Interface Buffer: 20.3 cm H x 20.3 cm W x 1.9 cm D (8 in H x 8 in W x 0.75 in D)

Weight: 5.44 kg (12 lb)

Ordering Information

Model

900 Dynamic Troubleshooter

Included with Instrument

900 Main Unit (RS-232 interface, standard), Interface buffer, 3 test clips: 16-pin, 0.3" (Y900-16D); 24-pin, 0.3" (Y900-24D); 28-pin, 0.6" (Y900-28D), data cartridge (Y900-001) (set of patch cords (Y900-005), RD tray/cartridge holder (Y900-003), user's manual, power cord.

Options and Accessories

Y900-001 One Data Cartridge
Y900-002 Set of Three (3) Data Cartridges (in tray Y900-004)
Y900-003 Ref. Device Tray & Cartridge Holder
Y900-004 Cartridge Holder (for 3 cartridges)
Y900-005 Set of Five (5) Patch Cords and Clips
Y900-006 Model 900 Carrying/Shipping Case

DIP Clips

Y900-8D Test Clip, 8-pin DIP (0.3")
Y900-14D Test Clip, 14-pin DIP (0.3")
Y900-16D Test Clip, 16-pin DIP (0.3")
Y900-20D Test Clip, 20-pin DIP (0.3")
Y900-24D Test Clip, 24-pin DIP (0.3")
Y900-24DW Test Clip, 24-pin DIP (0.6")
Y900-28D Test Clip, 28-pin DIP (0.6")

SMD Clips

Y900-8S Test Clip, 8-pin S.O.I.C.
Y900-14S Test Clip, 14-pin S.O.I.C.
Y900-16S Test Clip, 16-pin S.O.I.C.
Y900-20S Test Clip, 20-pin S.O.I.C.
Y900-24S Test Clip, 24-pin S.O.I.C.
Y900-28S Test Clip, 28-pin S.O.I.C.

90XX Series Microprocessor Interface Pods* Selection Chart

µP Supported	Pod Model #	µP Clock Speed
Z80A, Z80B	9000A-Z80QT†	8.0 MHz
Z8001, Z8002, Z8003, Z8004	9000A-Z8000†	10.0 MHz
1802, 1804, 1805, 1806	9000A-1802	5.0 MHz
6502	9000A-6502	2.0 MHz
6800	9000A-6800	2.0 MHz
6802, 6802NS, 6808	9000A-6802	2.0 MHz
6809, 6809E	9000A-6809	8.0 MHz
68000, 68010	9000A-68000†	10.0 MHz
8035, 8039, 8040, 8041, 8041A, 8042, 8048, 8049, 8050, 8741, 8742, 8748, 8749	9000A-8048	12.0 MHz
8031, 8032, 8044, 8051, 8052, 8344 8744, 8751	9000A-8051	12.0 MHz
8080	9000A-8080	3.0 MHz
8085A, 8085A-2	9000A-8085	5.0 MHz
8086. NEC V30 (70116)	9000A-8086†	10.0 MHz
8088, NEC V20 (70108)	9000A-8088†	8.0 MHz
80186	9000A-80186†	8 MHz
80188	9000A-80188†	8 MHz
80286	9000A-80286H	10 MHz
9900	9000A-9900	3 MHz

*These pods are supported by both the 90XX Series and the 91XX Series

†These pods include several Quick Test Functions

µP Supported	Required 9000A Pod	Pod Adapter Model #†
146805E2	9000A-8051	9000A-146805E2 PA-2
2650	9000A-Z80QT	
32CG16	9000A-80186	9000A-32CG16 PA-2
3870	9000A-8051	9000A-3870 PA-2
64180, Z180	9000A-Z80QT	9000A-64180 PA-2
6503, 6504, 6507,	9000A-6502	
6510, 6512		
68008	9000A-68000	
6801, 6301	9000A-6802	9000A-6801 PA-2
6801, 6301	9000A-6802	9000A-6801/A PA-2
6803, 6303	9000A-6802	9000A-6803 PA-2
6805R3, 6805	9000A-8051	9000A-6805 PA-2
68HC705,	9000A-6809	9000A-68HC705 PA-2
68HC705C8		
68HC11, 68HC711	9000A-6809	9000A-68HC11 PA-2
78220, 78224	9000A-80188	9000A-78220 PA-2
80152	9000A-8051	9000A-80152 PA-2
80451	9000A-8051	9000A-80451 PA-2
80515, 80535	90000A-8051	9000A-80535 PA-2
8094 - 8097, 80196	9000A-80186	9000A-809X PA-2
8X300, 8X305	9000A-Z80QT	
99000	9000A-8086	
9995	9000A-6802	
MAC-8	9000A-Z80QT	
NSC800	9000A-8085	
V25	9000A-80188	9000A-V25 PA-2
V40	9000A-80188	9000A-V40 PA-2
V50	9000A-80186	9000A-V50 PA-2
Z8	9000A-8051	9000A-Z8 PA-2

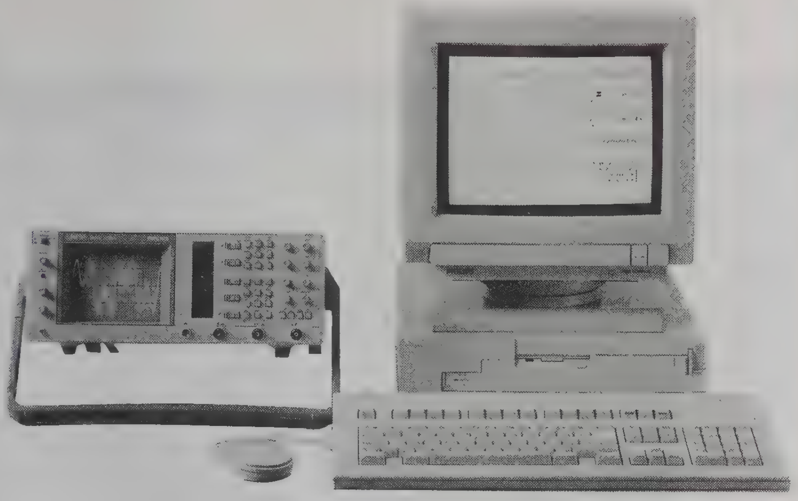
†The Microprocessor Pod Adapter model numbers above include the required 9000 Series Pod and just need the Pod Adapter, add a '-1' to the Pod Adapter model number.

Interface Pods

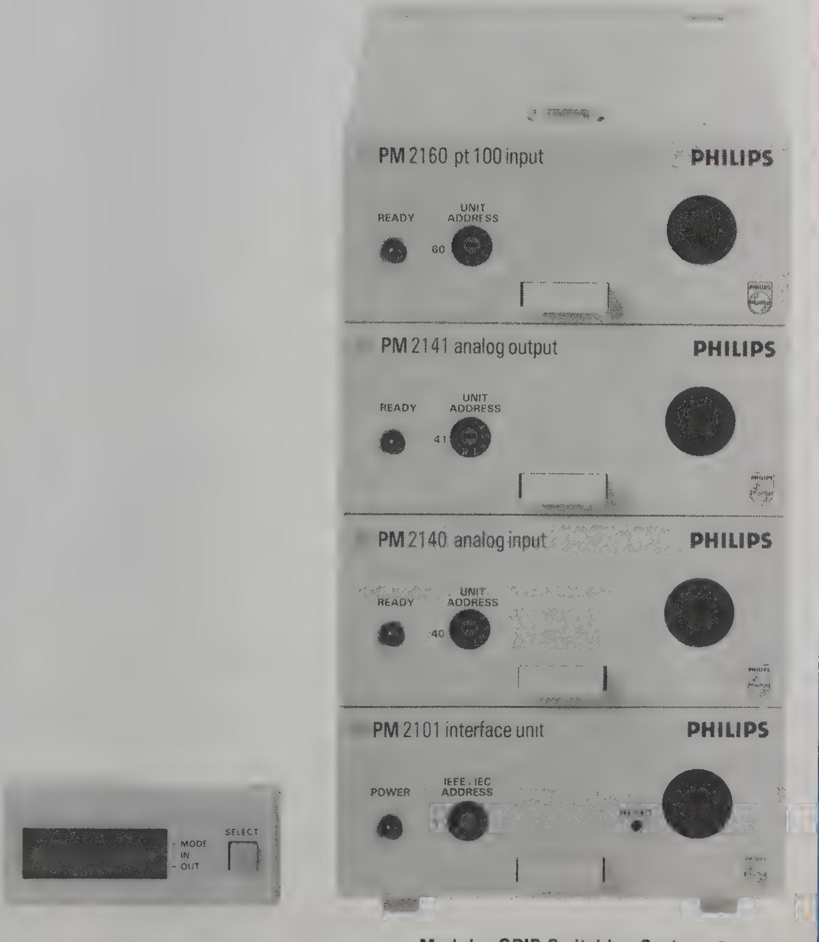
9132FT Memory Interface Pod Processor Support Package Selection Chart

µP Supported	PSP Model #	µP Clock Speed	Package Style Supported by Sync Module Adapter	Package Style Supported by Flying Leads
R2000	9132A-R2000	33 MHz (16.5 Mips)	144-pin PGA, socketed	
R3000	9132FT-R3000	66 MHz (33 Mips)	144-pin PGA, socketed	172-pin Ceramic Flatpack
32020 320C25 320C26	9132A-320C2X	50 MHz	68-pin PGA, socketed	68-pin PLCC
64180	9132A-64180	Highest rated 64180 clock speed	64-pin Shrink DIP, socketed	64-pin Shrink DIP, soldered Flat Pack-80
68HC11A0 68HC11A1 68HC11E0 68HC11E1	9132A-68HC11	Highest rated 68HC11 clock speed	52-pin PLCC, socketed	48-pin DIP
68000 68010	9132A-68000 9132A-68010	Highest rated CPU clock speed	68-pin PGA, socketed	68-pin PLCC 68-pin DIP
68020	9132FT-68020	40 MHz (0 wait states)	114-pin PGA, socketed	132-pin Surface Mount
68030 68EC030	9132FT-68030	40 MHz max (0 wait states) 50 MHz max (1 wait state)	128-pin PGA, socketed	132-pin Surface Mount
68040	9132FT-68040	25 MHz	179-pin PGA, socketed	
68302	9132FT-68302	20 MHz	132-pin PGA, socketed	
7810	9132A-7810	Highest rated 7810 clock speed	None	64-pin Shrink DIP/QUIP 68-pin PLCC 64-pin Miniflat Pack
80C88 8088	9132A-80C88	Highest rated80C88 clock speed	None	40-pin DIP (via supplied DIP clip) 44-pin PLCC
80C186 80C188 80186 80188	9132A-80C186	33 MHz	68-pin PLCC, soldered (PLCC clip supplied)	68-pin PGA 68-pin LCC
80286	9132FT-80286	50 MHz (CLK2)	68-pin PGA, socketed	68-pin LCC 68-pin PLCC
80386	9132FT-80386	66 MHz (CLK2)	132-pin PGA, socketed	
80386SX	9132FT-80386SX	50 MHz (CLK2)	None	100-pin PQFP
80486DX 80486SX	9132FT-80486	33 MHz max (0 wait states)	168-pin PGA, socketed	
80960 KA 80960 KB 80960 MC	9132FT-80960MC	25 MHz	132-pin PGA, socketed	164-pin CQP 132-pin PQP

Instrumentation Systems



LabWindows Software Page 302


PM 2160 pt 100 input
PHILIPS
READY
UNIT ADDRESS
60
PM 2141 analog output
PHILIPS
READY
UNIT ADDRESS
41
PM 2140 analog input
PHILIPS
READY
UNIT ADDRESS
40
PM 2101 interface unit
PHILIPS
POWER
IEEE / IEC ADDRESS
MODE
IN
OUT
SELECT

Modular GPIB Switching System Page 307

Fluke meets today's increasing need for automation in test & measurement by offering one of the widest ranges of GPIB-controlled instruments, switching and I/O units. GPIB controllers, software tools and experienced customer support services.

A wide range of instrumentation makes it easy for the user in R&D, manufacturing, service and education to select the required building blocks for his application from one supplier.

Fluke anticipates the requirements of users in R&D, manufacturing and education by offering an industrial GPIB controller for applications in manufacturing and process control. We also offer GPIB interface cards and PC software for applications that require flexibility and access to a wide range of software tools.

GPIB Selection Guide	Page 298
Introduction	Page 299
Software Selection Guide	Page 301
LabWindows	Page 302
Instrument Drivers Software	Page 304
Modular GPIB Switching System	Page 307
Switch Controller/Scanner	Page 314

GPIB
IEEE-488

Fluke Instrumentation Systems Selection Guide

The following is a selection chart listing all the Fluke test and measurement instruments that support the GPIB/IEEE-488* bus. For more information on a particular instrument, refer to its page in the catalog.

ANALOG OSCILLOSCOPES			Page
PM 3065	100 MHz Oscilloscope	G	30
PM 3070	100 MHz Oscilloscope with Cursors	G	30
PM 3050	60 MHz Oscilloscope	G	30
PM 3055	60 MHz Oscilloscope	G	30
PM 3092	200 MHz Oscilloscope	G	25
PM 3094	200 MHz True 4 Channel Oscilloscope	G	25

DIGITAL STORAGE OSCILLOSCOPES (DSOs)			
Fluke 97	25 Ms/s, 50 MHz ScopeMeter™	S	50
PM 3335	20 Ms/s, 60 MHz CombiScope™	G, S	21
PM 3350A	100 Ms/s, 60 MHz CombiScope	G, S	15
PM 3355	250 Ms/s, 60 MHz CombiScope	G, S	15
PM 3365A	100 Ms/s, 100 MHz CombiScope	G, S	15
PM 3375	250 Ms/s, 100 MHz CombiScope	G, S	15
PM 3382	200 Ms/s, 100 MHz, CombiScope	S, Ⓖ	6
PM 3384	200 Ms/s, 100 MHz, 4 Ch. CombiScope	S, Ⓖ	6
PM 3392	200 Ms/s, 200 MHz, CombiScope	S, Ⓖ	6
PM 3394	200 Ms/s, 200 MHz, 4 Ch. CombiScope	S, Ⓖ	6

LOGIC ANALYZERS			
PM 3580	Logic Analyzer, 32 Channel	S, G	273
PM 3585	Logic Analyzer, 64 Channel	S, G	273

SYNTHESIZED FUNCTION GENERATORS			
PM 5138	10 MHz Function/Arbitrary Generator	G	335
PM 5139	20 MHz Function/Arbitrary Generator	G	335
PM 5190X	2 MHz LF Synthesizer	G	333
PM 5191	2 MHz Synthesizer/Function Generator	G	326
PM 5192	20 MHz Synthesizer/Function Generator	G	326
PM 5193	50 MHz Synthesizer/Function Generator	G	326

ARBITRARY WAVEFORM GENERATOR			
PM 5150	20 MS/S, 32k Arbitrary Waveform Generator	G, S	321

TV & VIDEO PATTERN GENERATORS			
PM 5418TXI	Color TV Pattern Generators	G	370

COUNTERS			
PM 6652C	120 MHz/1.3 GHz/100 ns Timer/Counter	G	169
PM 6654C	120 MHz/1.3 GHz/2 ns Timer/Counter	G	169
PM 6666	120 MHz/1.3 GHz/100 ns Fully Prog. Timer/Counter	G	172
PM 6665	120 MHz/1.3 MHz/100 ns Timer/Counter	G	172
PM 6669	120 MHz/1.3 GHz Universal Frequency Counter	G	187
PM 6671	120 MHz/1 GHz/100 ns Timer/Counter	G	176
PM 6672	120 MHz/1 GHz/100 ns Timer/Counter	G	176
PM 6673	120 MHz Reciprocal Frequency Counter	G	183
PM 6674	550 MHz Reciprocal Frequency Counter	G	183
PM 6675	600 MHz Reciprocal Frequency Counter	G	183
PM 6676	1.3 GHz Reciprocal Frequency Counter	G	183
PM 6677	2.3 GHz Reciprocal Frequency Counter	G	183
PM 6680	225 MHz/4.5 GHz/500 ps Timer/Counter	Ⓖ	159
PM 6685	300 MHz/4.5 GHz Frequency Counter	Ⓖ	178

SYSTEM DIGITAL MULTIMETERS			Page
45	Dual Display Multimeter	G, S	66
8505A	Digital Multimeter, 6$^1/_2$ Digits	G, S	80
8506A	Thermal RMS Digital Multimeter, 6$^1/_2$ Digits	G, S	80
8520A	Intelligent DMM w/IEEE-488 Interface, 5$^1/_2$ Digits	G	85
8520A/AS-1	MATE Digital Multimeter	G	85
8520A/PRT	Precision Temperature System	G	85
8840A	Digital Multimeter, 5$^1/_2$ Digits	G	70
8840A/AF	Digital Multimeter, Mil-Spec Class B Inst., 5$^1/_2$ Digits	G	70
8842A	Digital Multimeter, 5$^1/_2$ Digits	G	70
8920A	DVM, BNC Input, 10 Hz-20 MHz	G	94
8921A	DVM, Banana Jack Input, 10 Hz-20 MHz	G	94
8922A	DVM, BNC Input, 2 Hz-11 MHz	G	94
PM 2525	Multifunction DMM, 4$^1/_2$/5$^1/_2$ Digits	G, S	76
PM 2534	System Multimeter, 5$^1/_2$ Digit	G, S	63
PM 2535	System Multimeter, 5$^1/_2$ Digit	G, S	63

INSTRUMENTATION SYSTEMS ELEMENTS			
PM 21XX	System 21 Modular GPIB Switching System	G	308
PM 2201	GPIB Interface Card & Software for PCs	G	306
PM 2202	MC-GPIB Interface Card & Software for PS/2	G	306
2205A	Switch Controller	G	314

CALIBRATORS			
5100B	Meter Calibrator	G, S	232
5101B	Meter Calibrator with Tape Deck	G, S	232
5102B	Meter Calibrator (military)	G, S	232
5130A	Calibration Workstation	G	229
5200A	Precision Alternating Voltage Calibrator	G	237
5205A	Precision Power Amplifier	G, S	241
5220A	Transconductance Amplifier	G, S	243
5440B	Direct Voltage Calibrator	G	235
5450A	Resistance Calibrator	G	240
5700A	Calibrator	G, S	224
5725A	Amplifier	G, S	224
5790A	AC Measurement Standard	G, S	254

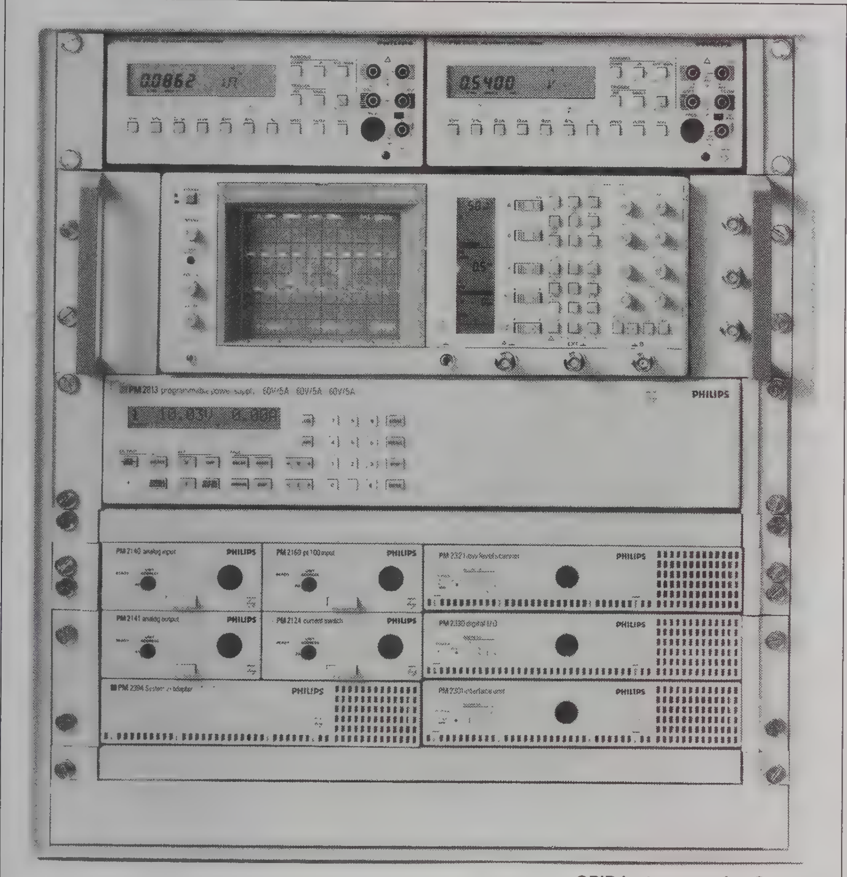
PROGRAMMABLE POWER SUPPLIES			
PM 2811	Single Output DC Supply (60W)	Ⓖ	315
PM 2812	Double Output DC Supply (60/120W)	Ⓖ	315
PM 2813	Triple Output DC Supply (3* 60W)	Ⓖ	315
PM 2831	Single Output Linear Power Supply (120W)	Ⓖ	315
PM 2832	Dual Output Linear Power Supply (2* 120W)	Ⓖ	315

DATA ACQUISITION			
2620A	Data Acquisition Unit	G, S	194
2625A	Data Logger	S	194
2635A	Data Bucket		194
2286A	Data Logging System		198
2287A	Helios Plus Data Acquisition Front End	S	202
2285B	Data Logger	G, S	198
2289A	Helios-I Data Acquisition Front End	S	202

DIGITAL TESTERS			
9020A-002	Micro-System Troubleshooter	G, S	291
9100FT	Digital Test System	G	287
9105FT	Digital Test Station	G	287
9110FT	Digital Troubleshooter		284

S - Serial
G - GPIB
Ⓖ - GPIB W/SCPI

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*



GPIB Instrumentation System

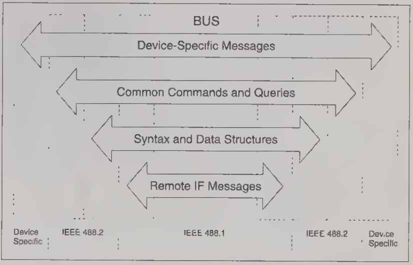
Fluke GPIB/IEEE-488.2

Fluke offers not only a wide range of sophisticated test and measurement instruments, but also controllers, software and switching units for GPIB/IEEE-488* instrumentation systems.

Next to the established IEEE-488 standard - now referred to as IEEE-488.1 - recently introduced instruments comply with the extended IEEE-488.2 standard. As new instruments are introduced, IEEE-488.2 compliance will become increasingly widespread.

A key aspect of this new standard is that it deals with the transmission of messages between devices on the bus. By ensuring compatibility at a higher level than IEEE-488.1, in which only the electrical and mechanical interfaces are standardized, the use of IEEE-488.2 further simplifies and supports the work of the system designer and integrator. Important IEEE-488.2 features include:

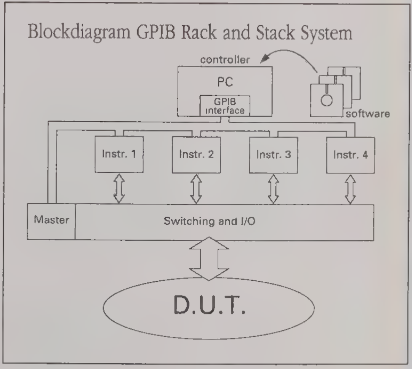
- IEEE-488.1 requirements - a minimum set of 488.1 interface capabilities is required. Additional capabilities are optional.
- Message exchange between talker and listener - a well defined protocol for the transmission of commands and measurement data is provided.
- Syntax definition - the syntax of program and response messages is precisely defined, and devices can listen in a 'forgiving' manner, increasing the accuracy of message transfer.
- Common commands - a basic command set is implemented in all instruments, and other commands for specific instruments are defined to ensure consistent implementation.
- Status reporting - the status reporting structure contains specific requirements on the implementation of the status byte.



The new IEEE-488.2 standard extends IEEE-488.1 by dealing with the transmission of methods between devices on the bus. Four new layers of IEEE-488.2 represent device functions, common system functions, message communications functions and interface functions. IEEE-488.1 device-dependent messages are contained in the outer three layers, while the inner layer contains IEEE-488.1 interface messages.

Standard Commands for Programmable Instruments (SCPI)

This new instrumentation language represents an extension of existing standards like IEEE-488 and VXIbus. SCPI standardizes commands and responses for the control of test & measurement instruments, and meets users' requirements for a common command set among such instruments. By standardization of commands among different manufacturers, SCPI avoids the need for users to learn separate command sets for individual instruments, and promotes product interchangeability in multi-vendor environments. Programming is further simplified by a comprehensive, 'plain English' command set. As a founding member of the SCPI industry consortium, Fluke has been involved from the start in the definition of SCPI, and many Fluke instruments already incorporate the SCPI command set.



Controller

The instrument controller is the central element in a GPIB instrumentation system. The test program covering instrument control, data processing/analysis and display will, in most cases, be developed and executed on the controller.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Introduction

PC-Based Controllers

The PC, with its excellent price/performance ratio and wide range of software and hardware options is now very popular as a GPIB/IEEE-488 controller. Fluke offers GPIB/IEEE-488 interfaces for the PC/XT and PC/AT (PM 2201) and PS/2 (PM 2202). A wide range of software tools eases program development and data acquisition and analysis.

Software

Fluke offers a wide range of software tools for PC-based GPIB/IEEE-488 controllers.

- Software for program development and execution
  - LabWindows PM 2250
  - First Class Instrument Drivers PM 2255
- Software for Waveform generation, aquisition, transfer and storage
  - AnyWave PM 2273 for waveform transfer to and from DSO's and arbitrary waveform generators
  - DSOCOM PM 2270 for waveform transfer to and from DSO via RS232C
  - Telegnostics PM 9372 for waveform transfer from DSO to PC via RS232C and modem

Instruments with GPIB/IEEE-488 Interface

Fluke offers a wide range of instruments with GPIB/IEEE-488 interface, like Oscilloscopes, Multimeters, Signal Generators, Counter/Timers, Logic Analyzers, Programmable Power Supplies and Data Acquisition units. All these instruments have been designed to operate on the bench or in a 19-inch rack cabinet for application in R&D, manufacturing and service applications.

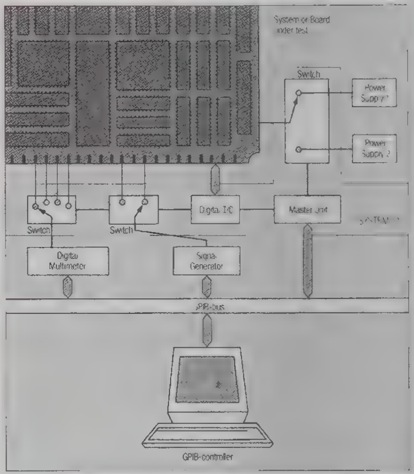
The Timer/Counter PM 6680, Programmable Power Supplies PM 2800 Series, and Combi-Scope Instruments PM 3380 and PM 3390 Series all support the industry standard, SCPI.

All instruments are supported in the above mentioned software packages to ease the use of instruments in automatic instrumentation applications.

Switching and I/O

Fluke offers a selection of GPIB-controlled switching and I/O systems to interconnect the UUT (Unit Under Test) and the instruments of the GPIB system, covering the requirements of a wide range of configurations and applications.

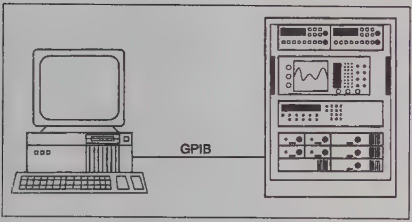
System 21 is a modular switching and I/O system for small-to-medium-size GPIB systems.



The Main building blocks of a GPIB system are:

- *Instruments*
- *Switches to connect the instruments to the device under test*
- *A GPIB controller for controlling the system and processing and displaying the measured data*

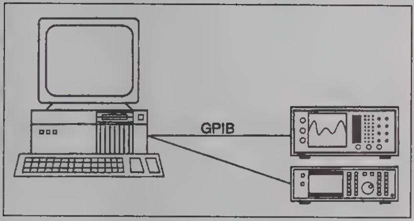
Software Selection Guide



LabWindows*

- Extended TestTeam version
- Creation of graphical user interface
- Test data handling
- Large test applications

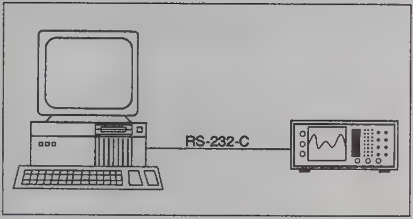
See page 302



AnyWave

- GPIB waveform transfer for DSO's and arbitrary waveform generators
- Graphic waveform display
- Graphic waveform editing
- Waveform limits checking and storage of failing waveform on disk

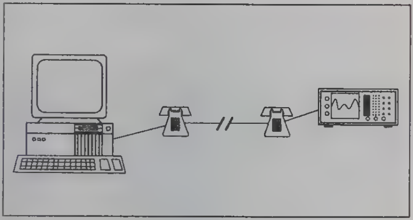
See page 325



DSOCOM

- RS-232 waveform transfer for DSO's
- Graphical waveform display
- Storage of waveform data on disk

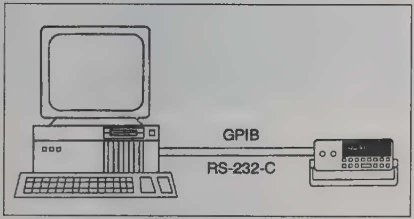
See page 47



Telegnostics

- Waveform transfer for DSO's via modem
- Graphical waveform display
- Storage of waveform data on disk

See page 47



Logger

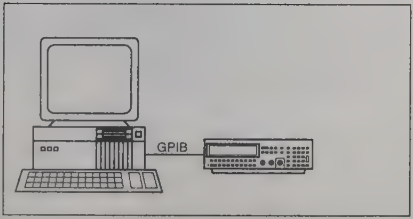
- Data transfer for Hydra via RS-232 or GPIB
- Graphical display and trend graph
- Storage of data on disk
- Store retrieve and send Hydra setups

See page 210

LabWindows*

- Automated control of Hydra via RS-232 or GPIB
- Creation of graphical user interfaces
- Interactive control and program generation

See page 302



TimeView

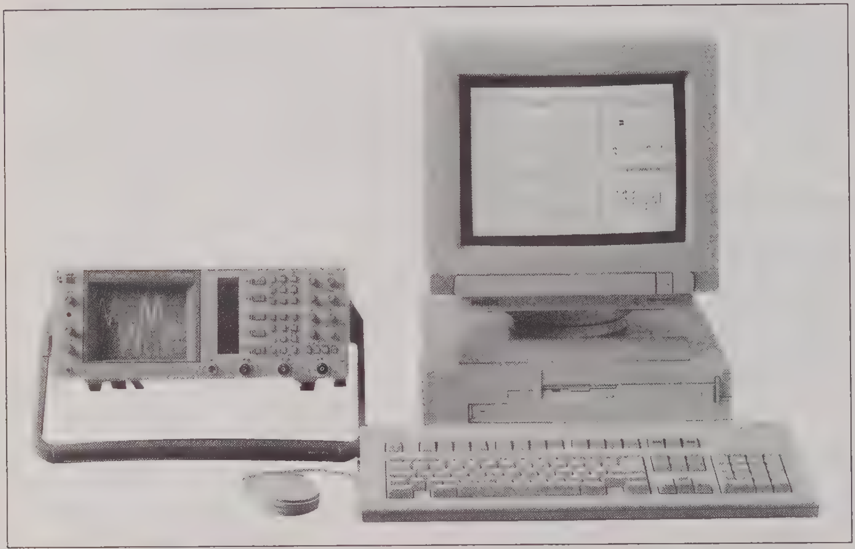
- Simple, cost-effective analysis in the modulation domain
- Histograms for distribution analysis of signal jitter
- FFT of frequency variations for modulation analysis
- Display of frequency vs time with accurate cursor measurements

See page 166

**Available in the U.S. through National Instruments, call 1-800-433-3488*

LabWindows

GPIB
IEEE-488



LabWindows®

- Interactive program generation for automatic testing
- Standard language programming in QuickBASIC, Professional BASIC or 'C'
- Automatic configuration program for fast start-up
- Wide range of ready-to-use instrument drivers
- Creation of easy-to-use programs with graphical user interfaces

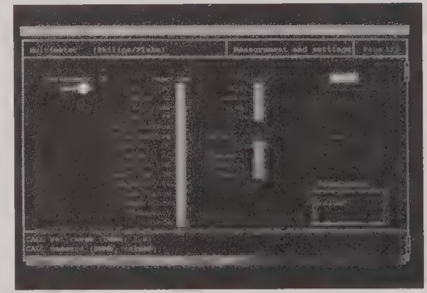
LabWindows provides a powerful yet easy-to-use development environment for advanced application programming, using the QuickBASIC, Professional BASIC or 'C' programming languages. With LabWindows, application program development is faster, simpler and more efficient.

Outside of the U.S., instrument drivers for Fluke products are sold together with LabWindows as the TestTeam Plus Package.

Quick-Start Programming

For a fast start to application programming, Fluke Instrument Drivers incorporate an automatic configuration utility that detects the supported Fluke instruments and instruments offered by other manufacturers and their GPIB addresses in any test system configuration, and automatically creates the corresponding start-up file. If desired, one of the standard framework 'template' application programs can be merged with the start-up file for quick-start programming.

First Class Instrument Drivers



When creating custom applications, the wide range of ready-to-use First Class Instrument Drivers for supported Fluke instruments remove much of the complexity of traditional GPIB application programming. All that's necessary is to select the desired instrument functions from a menu, and select the desired settings from an on-screen function panel display. The corresponding program code is then generated automatically. Traditional step-by-step programming of individual instrument functions is eliminated, which means a big reduction in programming time and effort, and less chance of programming errors. Time-consuming debugging is greatly reduced.

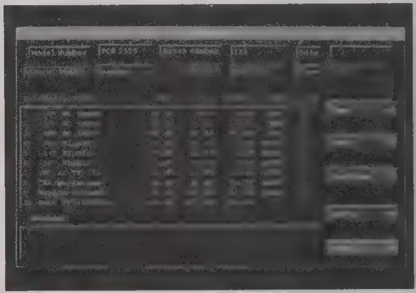
Wide Range of Supported Instruments

The supported Fluke instruments include digital multimeters, signal generators, programmable power supplies, data acquisition equipment, frequency counters and timers, CombiScopes and switching systems. Additional drivers are available on request for over 100 instruments from other manufacturers. Tools are also provided to let you create your own drivers and custom function panels for instruments which are not specifically supported.

Easy Creation of Executable Programs

LabWindows also includes a utility to automatically convert a program developed in LabWindows into a stand-alone executable file. So even if you're unfamiliar with compilation and link procedures, you can easily create executable programs using the compiler for your chosen programming language.

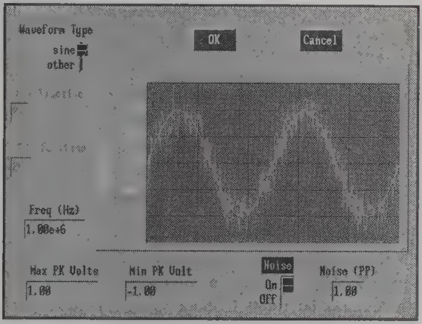
User-Friendly Interfaces for Functional Testing



In functional test applications, LabWindows lets you create user-friendly operator interfaces to clarify program execution, reduce errors and speed up testing. It's even possible to include gra-phical images for schematics and connections, to provide guidance on adjustments or other changes to the Unit Under Test. A standard user interface library makes it easy to design and control graphical user interfaces, and integrate them into application programs.

A built-in functional test tool kit of handy subroutines can read test limits from file, store test results on file, present test information on-screen and produce test reports – all with just a few simple commands. Extended functions are provided for handling test data and generating reports.

Automated Waveform Acquisition



Waveform Type
sine ■
other

Freq (Hz)
1.00e+6

Max PK Volts
1.00

Min PK Volt
-1.00

Noise
On ■
Off

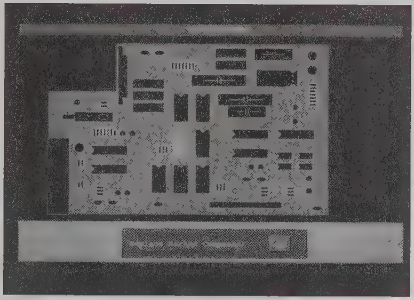
Noise (PP)
1.00

LabWindows also offers powerful facilities for automated waveform acquisition, display and post-processing, in combination with Fluke oscilloscopes, multimeters and data acquisition equipment. Built-in instrument drivers automatically capture the waveform, after which extensive graphics routines create on-screen presentations of the scaled waveform.

The optional Advanced Analysis Library includes many easy-to-use analysis, transformation and other processing functions, which eliminate the need to write special routines. The available functions include FFT, digital filters, integration, differentiation and statistical functions.

The state-of-the-art graphical user interface capabilities make designing automated waveform acquisition applications quick and easy. For example, you can create a user interface in which waveforms are presented – either statistically or scrolling – together with buttons, list boxes, slides and pop-up menus to define actions.

Larger-Than-Ever Application Programs



LabWindows overcomes the 640 KB limitation of the MS-DOS environment, and lets you create programs of up to 16 MB. So that even the most extensive test systems can be controlled by a single application program. The virtual memory facility allows these large appli-cation programs to be run even if you have only 2 MB of memory actually installed in your PC.

System Requirements

- IBM PC AT, PS/2 or compatible (80286 or higher processor)
- 2 MB RAM (4 MB recommended)
- One floppy and one hard disk drive (10 MB free)
- MS-DOS 3.0 or higher
- QuickBASIC 4.0, Professional BASIC 7.0, Microsoft 'C' 5.0, QuickC 2.0 or higher
- PM 2201 or PM 2202 (Micro Channel) GPIB interface card or National Instruments GPIB interface card

Ordering Information

Models

LabWindows can be ordered from National Instruments.

PM 2255 First Class Drivers Library
PM 2252 Run-Time System

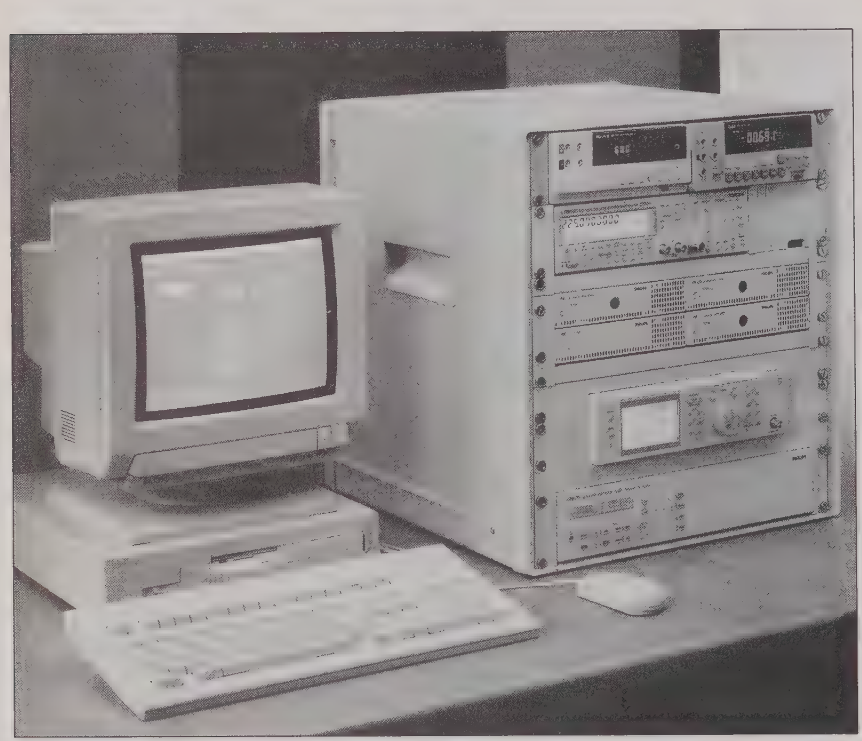
European Countries Only

PM 2250 TestTeam Plus, including LabWindows and First Class Instrument Drivers*
PM 2251 Advanced Analysis

**Available in the U.S. through National Instruments, call 1-800-433-3488.*

The following trademarks and registered trademarks are acknowledged: IBM, PC/XT, and PS/2: International Business Machines Corp. MS-DOS, Professional Basic, QuickBASIC, QuickC: Microsoft Corp. LabWindows: National Instruments Corp.

PM 2255



PM 2255 Instrument Drivers

- High-level instrument drivers ease programming and debugging
- Supports National Instruments LabWindows 2.2
- Supports Microsoft C, QuickC, QuickBASIC and Professional BASIC
- Fast, automatic system configuration utility program
- Includes low-level GPIB drivers to control other instruments

Users of National Instruments LabWindows 2.2 and Microsoft programming environments now have access to a broad library of fully documented and supported drivers for Fluke test and measurement equipment. Instrument drivers are a collection of subroutines that make the process of instrument control and data transfer easier. These drivers cover a wide range of specific Fluke GPIB instruments, including digital multimeters, signal generators, programmable power supplies, frequency counters and timers, oscilloscopes, and switching systems. We also include general GPIB procedures for programming instruments not supported by specific drivers.

Automatic Configuration Utility

Establishing communications with all the instruments in your test system used to be a challenge. The auto-configuration utility makes it easy by automatically determining the address and instrument type of all the instruments on the bus and setting up the communication links to those instruments. You can get started on your application program knowing that your test system is correctly configured.

Easier Program Development

High-level instrument commands, with easy to read syntax, free you from the task of learning the different GPIB mnemonics of each instrument and the details of low-level GPIB control. Using instrument drivers, your program is more readable, making documentation and software support activities easier. You spend less time debugging cryptic program lines.

The PM 2255 Instrument Drivers can automatically check command validity of your Fluke instruments. For example, out-of-range parameters are trapped before they are sent to the instrument, resulting in error-free instrument operation.

Instrument Drivers for LabWindows 2.2

LabWindows 2.2 users now have access to fully documented and supported instrument drivers. The PM 2255 Instrument Drivers are loaded into the LabWindows interactive environment, with full access to detailed instrument trees, function panels, and help menus. Instrument functions can be easily selected from a menu and settings can be entered in an on-screen function panel.

Instrument Drivers for Microsoft Programming Environments

The PM 2255 Instrument Drivers can be used together with Microsoft C version 5.0 or higher, Microsoft QuickC 2.0 or higher, Microsoft QuickBASIC 4.0 or higher, and Microsoft Professional Basic version 7.0 or higher. The user manual documents the high-level instrument commands and is organized by instrument type for easy access to all available instrument commands.

Run-Time System

The PM 2252 Run-Time System is for the user who wishes to create stand-alone application programs from programs developed in the LabWindows environment, either:

- as a run-time module with no need for a compiler (requires less memory)
- or compiled with a Microsoft QuickBasic, C, or Basic 7.0 compiler (compiled programs are tamper-proof and self-contained)

Either way, PM 2252 gives the user access to as much as 16 Mb of memory, the same as LabWindows, to overcome the 640 Kb DOS memory limitation for application purposes. (Use with LabWindows and PM 2255.)

Supported Instruments

Fluke is constantly adding support for new instruments. The current list of supported instruments includes:

Multimeters: 45, 8840A, 8842A, PM 2534, PM 2535, PM 2525
Generators: PM 5138, PM 5139, PM 5150, PM 5191, PM 5192, PM 5193
Counters: PM 6680, PM 6665, PM 6666, PM 6669, PM 6652(C), PM 6654(C)
Programmable Power Supplies: PM 2811, PM 2812, PM 2813, PM 2831, PM 2832
Switches: PM 2120, PM 2121, PM 2122, PM 2124
Oscilloscopes: PM 3335, PM 3350(A), PM 3355, PM 3365(A), PM 3375, PM 3382/84, PM 3392/94
Data Acquisition: 2620 (LabWindows 2.2 only)
ScopeMeter: 97 (LabWindows 2.2 only)
Logic Analyzers: PM 3585 (LabWindows 2.2 only)

System Requirements

With LabWindows 2.2:

- IBM PC AT, PS/2 or 100% compatible
- Minimum 2 MB RAM and hard disk
- PM 2201 or PM 2202 GPIB interface card or National PCII/IIA or MC-GPIB

With Microsoft QuickBASIC, Professional BASIC, C or QuickC:

- IBM PC XT, AT, PS/2 or 100% compatible
- Minimum 512 KB RAM and hard disk
- PM 2201 or PM 2202 GPIB interface card or National PCII/IIA or MC-GPIB

Ordering Information

Models

PM 2255/001 Instrument Drivers
PM 2252 TestTeam Plus Run-Time System
PM 2255/901 Multi-Copy Version
PM 2201/98 GPIB Interface for PC Bus
PM 2202/98 GPIB Interface Card for Micro-Channel Bus

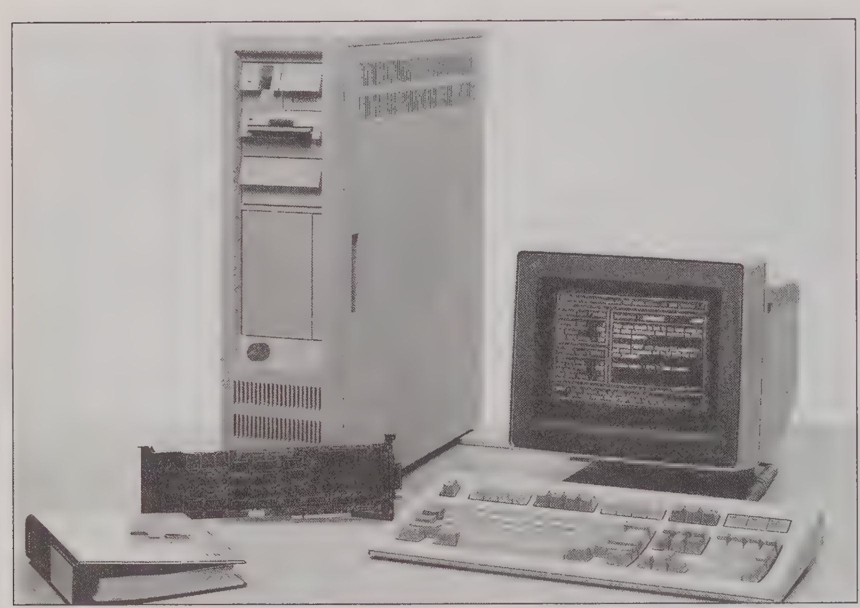
Included with Package

PM 2255 includes a 100 page user manual, 3.5" and 5.25" floppy disks, and software user registration card.

The following trademarks and registered trademarks are acknowledged: IBM, PC/XT, PC/AT, and PS/2: International Business Machines Corp. MS-DOS, Professional Basic, QuickBASIC, QuickC: Microsoft Corp. LabWindows: National Instruments Corp.

PM 2201 & PM 2202

SCPI
GPIB
IEEE-488



GPIB/IEEE-488.2 Interfaces for PC & PS/2

- Turns Personal Computer into versatile GPIB system controller
- Supports MS-DOS and Windows 3 operating environment
- Supports Visual Basic, QuickBasic, Turbo Pascal and Microsoft C programming languages
- Fully compatible with SCPI, IEEE-488.2 and other GPIB instruments
- Supports LabWindows™, LabView®, MET/CAL™, AnyWave, TimeView and a whole range of other software packages

Hardware

The PM 2201 and PM 2202 interface cards are a quick, convenient and economical way to convert GPIB instruments with a PC or PS/2 computer.

The PM 2201 contains the widely used PC II/IIA GPIB interface from National Instruments for the IBM PC/XT/AT and 100% compatibles. The PM 2202 contains the MC-GPIB interface for IBM PS/2 models with the Micro Channel bus.

The widespread acceptance of these cards ensures total compatibility with the many software packages designed for use with them.

Software

With the PM 2201/03 and PM 2202/02, a library of GPIB routines is supplied that can be called from one of the supported programming languages. These routines comply with the controller functionality of the IEEE-488.2 specification. Also non-IEEE-488.2 instruments can be controlled with these routines.

For Windows 3.x, a GPIB Dynamic Link Library is supplied. This can be used by any Windows application or programming language to control the GPIB interface. For Visual Basic and MicroSoft C an include file is available to facilitate the programming effort. Example programs are included that demonstrate programming with Visual Basic. One example demonstrates the acquisition and display of waveforms from a CombiScope™. Another example demonstrates the control of a Programmable Power Supply.

The PM 2201/98 and PM 2202/98 interface cards are a lower cost alternative that can only be used in conjunction with another software package. With these versions only the GPIB device driver is supplied.

Example Program Section

```
REM  Inititalize GPIB interface
CALL SendIFC(0)

REM  Send string to address 8 on interface board 0
REM  End string with NewLine and END-message
     (EOI)
CALL Send (0  ,  8,  "IDN?, NLEND)

rd$  = SPACE$ (50)

REM  Read string from address 8 on interface board 0
REM  Stop reading when END-message (EOI) is
     received
CALL Receive (  0,  8,  rd$, STOPEND)

REM  Print the received characters
REM  The amount of characters is indicated by ibcnt
PRINT "Response:  ";  LEFT$ (rd$, ibent%)
```

System Requirements

- **PM 2201:** IBM PC/XT/AT or PS/2 models with PC-bus or compatible
  PM 2202: IBM PS/2 models with MicroChannel-bus
- Memory: 640K
- MS-DOS/PC-DOS 3.0 or higher or Windows 3.0 or higher
- Floppy disk and one hard disk drive
- Visual Basic 1.0, QuickBasic 4.5, MicroSoft C 5.0, Borland Turbo Pascal 5.5 or higher versions

Ordering Information

Models

PM 2201/03 GPIB Interface for PC, with GPIB Driver Software
PM 2201/98 GPIB Interface for PC, without GPIB Driver Software*
PM 2202/02 GPIB Interface for Micro Channel with GPIB Driver Software
PM 2202/98 GPIB Interface for Micro Channel without GPIB Driver Software

** Includes GPIB.COM device driver*

Accessories

Y8021 GPIB Interface Cable, 1m
Y8022 GPIB Interface Cable, 2m
Y8023 GPIB Interface Cable, 4m

Microsoft, MS-DOS, QuickBasic, VisualBasic are trademarks of Microsoft Corp. IBM, PS/2 MicroChannel are trademarks of International Business Machines Corp. LabWindows, LabView are trademarks of National Instruments. Turbo Pascal is a trademark of Borland Int.

** GPIB = General Purpose Interface Bus; equivalent to IEC-625.1 and IEEE-488 standards*
SCPI = Standard Commands for Programmable Instruments

System 21 Selection Chart

Master and Custom Units							Maximum Power	Connector Type	Description
PM 2101	GPIB Master Unit						16 VA	GPIB	Controls and powers up to 50 slave units. Uses only one GPIB address.
PM 2150	Customer Adaptable Unit						200 mA at 5V ±5%	Euroconnector for a Eurocard	Allows the development of custom slave units. Uses 5V CMOS or TTL chips.

Switches		Number of Switches				Switching Speed	Maximum Switching Power	Connector Type	Description
		Mode 1	Mode 2	Mode 3					
PM 2120	Universal Switch	20	10	10		10 to 20 ms Note 1	30V 200 mA	37 pin (D) female	20 individual ON/OFF switches. 10 SPDT over switches.
PM 2121	Low Level Switch (3 μV Thermal Offset)	20	10	4		<10 ms Note 1	24V 500 mA	37 pin (D) female	1, 2 or 4 pole switching, with guard lines protected against current transitions.
PM 2122	50Ω Coaxial Switch	4	—	—		<10 ms Note 1	24V 250 mA		A VHF coaxial switch with a 50Ω impedance for dc to 500 MHz.
PM 2124	Current Switch	6	—	—		(50 + 50 x n) ms n=1 to 6 Note 1	2500 VA ac 300W dc	Amphenol 97 Series	Allows the switching of high currents and high voltages, 10A and 250V.

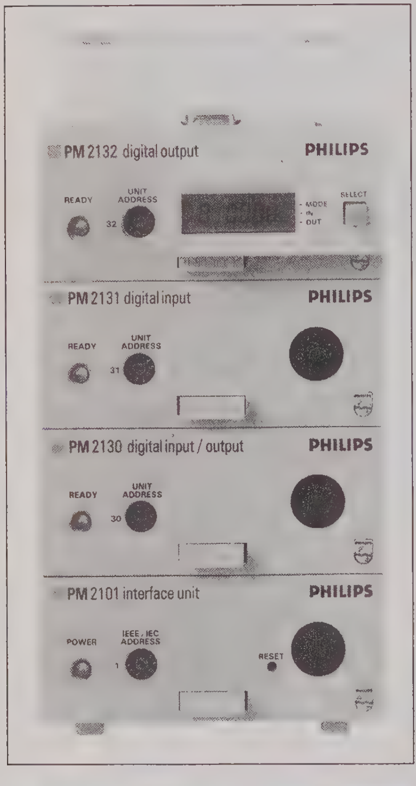
Digital Input/Output		Number of Channels				Switching Speed	Maximum Voltage	Connector Type	Description
		Inputs	Outputs						
PM 2130	Digital Input/Output	2 x 4	8			<8 ms Note 1	30V rms	37 pin (D) female	2x4 optically isolated inputs and 8 optically isolated outputs.
PM 2131	Digital Input	4 x 4	—			<8 ms Note 1	30V rms	37 pin (D) female	4x4 optically isolated inputs, externally powered.
PM 2132	Digital Output	—	2 x 8			<8 ms Note 1	30V rms	37 pin (D) female	2x8 optically isolated outputs, protected against short circuiting & inductive loads.

Data Acquisition		Input/Output Ranges				Measurements Per Second	Maximum Power of the Switching Relay	Connector Type	Description
		Voltage			Current				
		Range 1	Range 2	Range 3	Range 1				
PM 2140	Analog Input Resolution:	200 mV 10 μV	2V	20V	250 mA 10 μA	1.6 to 10	10W	37 pin (D) female	An Analog-to-Digital converter with programmable high and low limit relays.
PM 2141	Analog Output Resolution:	±2V 1 mV	±20V 10 mV	—	±20 mA 10 μA	—	—	37 pin (D) female	A 12-bit Digital-to-Analog converter with two voltage and one current range.
PM 2160	Pt-100 Temperature Unit	Pt-100 RTD	—	—	—	.8 to 2	10W	37 pin (D) female	An input module for Pt-100 RTDs with programmable high and low limit relays.

Note 1: These times work out to approximately 10 per second for an average combination of Slave Units programmed in BASIC on a PC, using block programming mode.

System 21

SCPI
GPIB
IEEE-488



System 21 Modular GPIB Switching System

- Modular architecture
- Large range of different units for large number of applications
- For on the bench or in a rack
- Easy configuration

System 21 offers you simple, low-cost solutions for flexible configuration of your GPIB switching systems. A choice of 12 functional units cover a wide range of functions, including switching digital I/O and analog-digital/digital-analog conversion. Add special-purpose modules like a Pt 100 temperature unit, a custom user-adaptable unit and a display module and you get easy-to-use extra functionality. All helping you to create exactly the system you need, with the minimum of complexity. The System 21 Master Unit handles all communication with the GPIB bus. So the switching system occupies only a single bus address, allowing maximum freedom in instrumentation system configuration. Up to 50 slaves can be connected to the Master Unit, using the System 21 Power Supply Unit if additional power is needed. Connection couldn't be simpler – the System 21 modules just click together, mechanically and electronically.

Simpler Programming; Less Coding

All system operations are controlled by simple commands. Each module works independently, and can store commands for later triggering by the controller. That means simpler programming, and far less coding of repetitive tasks. In addition, most modules have multiple operating modes. So you can increase flexibility by configuring each module several ways. The Universal Switch, for example, can be configured three ways: as 20 individual on/off switches, as 10 break-before make switches, or as 10 make-before-break switches. Similarly, the digital input/output units can be used in either direct or latching modes. All units have multiple execution modes, including a scan mode to activate individual switch inputs in sequence with minimum coding - yet another way to simplify your work. With System 21, GPIB testing has never been so easy. You control the entire system though one Master Unit, using one controller and easy-to-use software intelligence is distributed throughout the system for easy programming. And you can reconfigure your system any way you want, quickly and easily.

Specifications

Display Module: The optional PM 2190 Display Module can be plugged into the front panel socket of each unit, except the Master Unit, to provide status information.
Terminal Connector: One or more terminal connectors are provided on the rear panel of each unit

Environmental Data

Operating Temperature: 0 + 55°C
Storage Temperature: -40 + 75°C
Humidity: 80% (0 + 55°C)
Dew point: 25°C

Mechanical Data

Mechanical Construction: All units are housed in a separate box. Mechanical interconnection to the master and other units is by means of the feet of each unit.
Size: 105 mm W x 44.4 mm H x 226 mm L (4.3 in W x 1.7 in H x 8.9 in L) (excluding connectors and feet)
Height of Feet: 11 mm (0.43 in)

Module Specifications

PM 2101 Master Unit

The PM 2101 Master Unit provides the power supply to the complete system and handles communication between the GPIB interface bus and the System 21 internal bus.

Bus Communication

Communication between the GPIB bus and the internal bus is fully transparent. Messages addressed to the Slave Units are not influenced by the Master Unit

Power Supply

Power: 110, 120, 220 or 240V AC ±10%, 50 Hz or 60 Hz
Power Consumption: 16 VA max
Safety: Class II acc. to IEC 348
Secondary Power Supply to Slave Units: 7.5V (at full load) to 15V (unloaded)
Maximum Current Load: 750 mA (If higher currents are needed, additional PM 2198 power supply units can be used in parallel)

System Control Functions

Control functions of the Master Unit include identification, synchronization and service request handling

Identification

On request, the Master Unit returns with:
a. Type number and version of the Master Unit
b. List of connected Slave Units

Trigger Facilities

Trigger commands from the GPIB bus can be distributed at choice to:

- Individual units
- All units with identical type numbers
- All units

If required, these trigger commands can be delayed until the ready line is "true"

Reading the Ready Line

On request, the Master Unit returns with the status of the ready line

Resetting the System

The system can be reset to power-on conditions via the GPIB bus, or by means of a (protected) reset button on the Master Unit

Service Request Handling

The Master Unit includes masking facilities to select from several reasons for service request messages. These include:

- Power failure or illegal code
- Addressed unit is not present or has synchronization error
- A unit has data available, has reached end of block or has a functional warning
- Changes in ready or trigger line

The Master Unit returns with detailed information on the source of the service request call by means of a polling procedure after a service request is received.

GPIB Interface Data

Interface Functions:

Description	Function	Capability
Source handshake	SH1	Complete
Accepter handshake	AH1	Complete
Talker function	T6	No talk only
Listener function	L4	No listen only
Service request	SR1	Complete
Remote/Local	RLO	No local control
Device clear	DC1	Complete
Device trigger	DC1	Complete

Address Setting: 10 to 19

Accepted Input Data:

- Control data for Slave Units, Master Unit and interface
- General multiline commands; DCL, SPE, SPD, GET, SDC

Output Data: Functional messages, status and error messages of the units.

Separators: Record separators can be software programmed to one or two characters. At power-on, record and block separator are "NL".

Service Request: The following reasons for a service request can be enabled or disabled under software control; illegal header or body, System 21 request.

Connector: Standard GPIB connector.

PM 2120 Universal Switch

The PM 2120 Universal Switch offers 20 switches grouped in 10 pairs, each with a common contact. Depending on the switching mode setting, the switches can be used as:

- 20 individual on/off switches with one common contact per pair; or
- 10 single pole double throw (SPDT) break-before-make or make-before-break switches.

The contacts are high quality reed relays able to handle 200 mA, 30V and frequencies up to 100 kHz.

Technical Specifications

Configuration: 10 elements of 2 switches with a common output

Operating Modes

Mode 0: 20 individual switches (with common output per pair) for multiplexing or matrix switching

Mode 1: 10 SPDT make-before-break

Mode 2: 10 SPDT break-before-make

Maximum Switching Voltage: 30V rms

Maximum Switching Current: 200 mA

Maximum Switching Power: 10 VA (resistive load)

Maximum Common Mode Voltage between Terminals or between Terminal and Ground: 30V rms ac or 42V dc

Frequency Range: DC to 100 kHz

Series Resistance: <0.5Ω

End-of-Life Resistance: <2Ω

Open Contact Resistance: $>10^9\Omega$

Isolation Resistance: $>10^9\Omega$

Crosstalk Isolation: 60 dB at 100 kHz, $R_0=50\Omega$

Switching Time Individual Relay: <10 ms, until last relay has settled in any mode: <25 ms, break-before-make or make-before-break; 10 to 20 ms

Maximum Switch Rate: 15/sec

Terminal: 37-pin female D-type connector

Display Module: The optional PM 2190 Display Module shows:

- Switching mode, synchronization mode and ready status
- Settings of individual switches

Current Consumption for System Supply: 25 mA (all switches open) to 125 mA (all switches closed)

PM 2121 Low-Level Switch

The PM 2121 Low-Level Switch offers 5 switches (each 4 wires + guard) at the input, and mode-switching at the output. Depending on the switching mode, the switches can be used for scanning of:

- 20 channels of 1 wire + guard (guard in common for 4 channels)
- 10 channels of 2 wires + guard (guard in common for 2 channels)
- 5 channels of 4 wires + guard

Switch contacts are matched to the special requirements of switching at low signal levels. The contact potential is <3 µV

Technical Specifications

Configuration: 5 elements of 4 contacts + guard at the input and a mode switching unit at the output

Operating Modes

Mode 1: 1 wire (+ guard) scanning of 20 inputs

Mode 2: 2 wire (+ guard) scanning of 10 inputs

Mode 4: 4 wire (+ guard) scanning of 5 inputs.

A common guard for 4 contacts is used in all modes

Maximum Switching Voltage: 24V rms

Maximum Switching Current: 500 mA rms

Maximum Switching Power: 12 VA (up to 1 MHz)

Maximum Common Mode Voltage Terminals or Between Terminal and Ground: 24V rms ac or dc

Frequency Range: DC to 1 MHz

Series Resistance: <1Ω

End-of-Life Resistance: <2Ω

Open Contact Resistance: $>10^9\Omega$

Isolation Resistance: $>10^9\Omega$

Crosstalk Isolation: >90 dB (50/60 Hz); >40 dB (1MHz)

Switching Time Individual Relay: <10 ms, until last relay has settled in any mode: <25 ms

Maximum Switch Rate: 10/sec.

Terminal: 37-pin female D-type connector

Display Module: The optional PM 2190 Display Module shows:

- Switching mode, synchronization mode and ready status
- Selected channel

Current Consumption from System Supply: Typical 25 mA, max. 50 mA

PM 2122 50Ω Coaxial Switch

The PM 2122 50Ω Coaxial Switch Unit offers facilities for the selection of one of four inputs to the output.

The unit is suitable for switching VHF signals up to 500 MHz and 24V rms. Matching impedance is 50Ω

Technical Specifications

Switch Configuration: 4 single pole double throw switches selecting 1 of 4 inputs

Operating Mode: Fixed

Matching Impedance: 50Ω (open inputs are not terminated)

Maximum Switching Voltage: 24V rms ac

Maximum Switching Current: 250 mA rms

Maximum Switching Power: 3 VA (50Ω load)

Maximum Common Mode Voltage between Terminals or between Terminal Ground: 24V rms ac or dc

Frequency Range: DC to 500 MHz

VSWR: <1.2 at 100 MHz; <1.5 at 500 MHz

Series Resistance: <1Ω

End-of-Life Resistance: <2Ω

Open Contact Resistance: $>10^8\Omega$

Isolation Resistance: $>10^8\Omega$

Crosstalk Isolation: >50 dB at 100 MHz, >25 dB at 500 MHz

Switching Time Individual Relay: <10 ms, until last relay has settled: <25 ms

Terminals: 50Ω BNC connectors

Display Module: The optional PM 2190 Display Module shows:

- Synchronization mode and ready status
- Selected channel

Current Consumption from System Supply: Typical 35 mA, maximum 60 mA

PM 2124
1
2
250V MAX
250V MAX

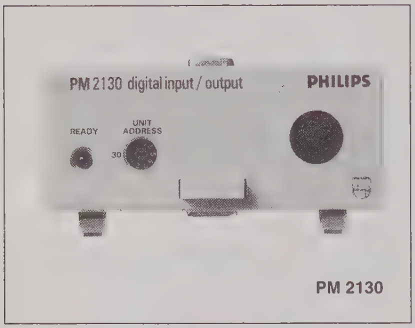
PM 2124

PM 2124 High Current Switch

The PM 2124 High Current Switch offers 6 independently controlled bistable switches in groups of three connected to two terminals. It can switch ac power up to 2500 VA and dc up to 300W. The high current switch is for testing motors and other electro-mechanical devices, and the switches are provided with earth connections. They meet the IEC 348, Class 1 safety specifications.

Technical Specifications

Configuration: 6 independently controlled bistable switches in 2 groups of 3
Operating Mode: Fixed
Maximum Switching Voltage: 250V rms ac, 400V dc
Maximum Switching Current: 10A ac at up to 250V, 10A dc at up to 30V, max. 25A per terminal
Maximum Switching Power: 2500 VA ac, 300W dc
Series Resisitance: <50 mΩ
Isolation Resistance: 2 MΩ
Cross Talk Isolation: Negligible up to 1 kHz
Inrush Current: 50A
Switching Time: Bistable relays switched in sequence - total switching time 50 ms + (n x 50 ms) for n contacts.
Maximum Switch Rate: 8/sec.
Terminals: 2 x Amphenol series 97 terminals. Two corresponding plugs also supplied
Display Module: Optional PM 2190 shows position of relays.
Current Consumption From System Supply: Typically 25 mA



PM 2130

PM 2130 Digital I/O Unit

The PM 2130 Digital Input/Output Unit provides 8-bit input and output with optical isolation for signal levels from 0V to 5V to 0V to 30V. Outputs can be loaded up to 100 mA. The inputs can be used as latching input, and can set a warning flag when they match a reference pattern.

Technical Specifications

Configuration: 2 groups of 4-bit input and 1 group of 8-bit output with a common return line per group

Operating Modes
Mode 0: 8 input bits and 8 output bits
Mode 1: 8 latching input bits and 8 output bits
Latching Mode: In the latching mode a latch is set when the corresponding input is high for a period of >1 ms. The latches are reset by the RSL command.
Reference Facility: By setting a reference for the individual inputs to "don't care", low, high or changing state, a matching input or a change in input can be detected. The corresponding warning flag can be used to generate a service request message.
For Input/Output Details: See Table 1

Timing
Response Time on Setting Commands: <8 ms
Response Time on Read Commands: <8 ms
Minimum Pulse Width to Set "Match Reference" Flag: 5 ms
Minimum Pulse Width to Set Latch: 0.5 ms
Maximum Input/Output Rate: 15 bytes/sec.
Terminal: 37-pin female D-type connector
Display Module: The optional PM 2190 Display Module shows:
- Synchronization mode and ready status
- Data sent to the output
- Logic states of the inputs

Current Consumption: <100 mA

PM 2131 Digital Input Unit

The PM 2131 Digital Input Unit provides 16-bit optically isolated input subdivided into 4 groups of 4 bits. Signal level is 0V to 5V to 0V to 30V. The inputs can be used as latching input. The inputs can be compared with preset reference to check on state or change of state.

Technical Specifications

Configuration: 4 groups of 4-bit input with optical isolation and a common return line per group

Operating Modes
Mode 0: 16 input bits
Mode 1: 16 latching input bits
Latching Mode: In the latching mode a latch is set when the corresponding input is high for a period of >1 ms. The latches are reset by the RSL command.
Reference Facility: By setting a reference for the individual inputs to "don't care", low, high or changing state, a matching input or a change in input can be detected. The corresponding warning flag can be used to generate a service request message.
For Input Details: See Table 1

Timing
Response Time on Setting Commands: <8 ms
Response Time on Read Commands: <8 ms
Minimum Pulse Width to Set "Match Reference" Flag: 5 ms
Minimum Pulse Width to Set Latch: 0.5 ms
Maximum Input Rate: 15 words/sec.
Terminal: 37-pin female D-type connector
Display Module: The optional PM 2190 Display Module shows:
- Operating mode, sychronization mode and ready status
- Logic states of the inputs

Current Consumption: <80 mA

PM 2132 Digital Output Unit

The PM 2132 Digital Output Unit provides 16-bit optically isolated output subdivided into 2 groups of 8 bits. Signal level is 0V to 5V for 0V to 30V. The outputs can be loaded up to 100 mA.

Technical Specifications

Configuration: 2 groups of 8-bit output with optical isolation, and a common line per group
For Output Details: See Table 1

Timing
Response Time on Setting Commands: <8 ms
Maximum Output Rate: 15 words/sec.
Terminal: 37-pin female D-type connector
Display Module: The optional PM 2190 Display Module shows:
- Synchronization mode and ready status
- Data sent to the output

Current Consumption from System Supply: <200 mA

Table 1. Input and Output Specifications for PM 2130, 2131, 2132

	Input	Output
Common Mode Voltage Between Groups and Ground	30V rms ac or 42V dc	30V rms ac or 42V dc
External Supply Voltage	5 to 30V(max)	5 to 30V(max)
External Supply Current	<10 mA (per group of 4-bit)	<1A (per group of 8-bits and including max load current)
Logic	Positive	Positive (current source)
Levels	Low for <30% of supply voltage High for >70% of supply voltage	
Hysteresis	0.4V to 1.7V	
Input Voltage Range	-30 to +30V	
Input Resistance	100 kΩ	
Input RC Time	0.1 ms	
Max Load Current		100 mA (outputs may be used in parallel)
Output Voltage		Supply voltage -1V at 100 mA load
Current at Output Low		<1 mA
Output Protection		Short-circuit protected and flyback diodes

PM 2140 Analog Input

The PM 2140 Analog Input offers a 3 range input channel for dc voltages up to 25V, and a separate single range current input up to 250 mA. The two inputs have a common floating low and are provided with a guard.

Maximum resolution is 10 µV in the 200 mV range and 10 µA in the current range. Measuring speed is 1.6 or 10 measurements per second. An input filter can be switched on for increased SMRR.

The PM 2140 also includes two relays that can be activated by the input signal when passing a programmable high or low limit. The contacts of these relays are connected to rear mounted terminals.

Technical Specifications

Configuration: 3 range dc voltage and single range dc current input with floating low and a guard. High and low limit detection with relays for external signaling.

Operating Modes

Mode 0: Measurements with 4.5 digit resolution
Mode 1: Measurements with 3.5 digit resolution
For Ranges and Accuracy: See Table 2

Limit Detection

Limit Setting Range: -25,000 to +25,000 counts for mode ø; -25,000 to + 25,000 counts for mode 1

For Both High and Low Limit
Maximum Limit Relay Load: 10W
Maximum Voltage: 30V rms or 42V dc
Maximum Current: 500 mA
Start of Measurements: Free-running or triggered via the GPIB bus, measuring results are available 80 ms (mode 1) or 600 ms (mode 0) after start of measurement

Terminal: 37-pin female D-type connector
Display Module: The optional module PM 2190 shows:
- Operating mode, trigger mode and ready status
- Measured value
- High limit setting
- Filter on/off

Current Consumption from System Supply: Max <100 mA

Table 2. PM 2140 Ranges & Accuracy

	VDC 200 mV	VDC 2V	VDC 20V	IDC 200 mA
Reading Ranges				
Mode 0	±250.00 mV	±2.5000V	±25.000V	±250.00 mA
Mode 1	±250.0 mV	±2.500V	±25.00V	±250.0 mA
Max Resolution	10 µV	100 µV	1 mV	10 µV
Accuracy: % of Reading ±% of Range	0.1 ±0.02	0.1 ±0.02	0.1 ±0.02	0.25 ±0.05
Temp Coeff %/°C	0.01	0.005	0.005	0.05
Input Characteristic	1 MΩ	10 MΩ	10 MΩ	1Ω
SMRR (at 50 Hz)				
Mode 0 filter on	>60 dB	>70 dB	>70 dB	
filter off	>40 dB	>50 dB	>50 dB	
Mode 1 filter on	>50 dB	>60 dB	>60 dB	
filter off	>30 dB	>40 dB	>40 dB	
Input Settling Time for Last Digit				
Mode 0 filter on	750 ms	750 ms	750 ms	450 ms
filter off	150 ms	150 ms	150 ms	100 ms
Mode 1 filter on	550 ms	550 ms	550 ms	350 ms
filter off	75 ms	75 ms	75 ms	75 ms
CMRR	100 dB at dc 80 dB at ac (50 Hz)	100 dB at dc 80 dB at ac (50 Hz)	100 dB at dc 80 dB at ac (50 Hz)	100 dB at dc 80 dB at ac (50 Hz)
Avg Measuring Speed				
Mode 0	1.6 per second	1.6 per second	1.6 per second	1.6 per second
Mode 1	10 per second	10 per second	10 per second	10 per second
Maximum Load	42V dc (tested up to 250V rms)	42V dc (tested up to 250V rms)	42V dc (tested up to 250V rms)	1.5A average and 10A peak

PM 2141 Analog Output Unit

The PM 2141 is a 12-bit Digital-to-Analog Converter, which offers a choice of both voltage and current output modes. The voltage output mode has two ranges, ±2V and ±20V and the current output mode has one range, ±20 mA. The voltage and current output modes have a resolution of 2000 digits. Both of the outputs are floating with respect to the system and safety grounds. For safe operation, the output voltage must never exceed 42V (dc or dc + ac peak). The voltage output has optional separate sensing wires to eliminate voltage drop across the output wires. This option allows a power supply to be added to increase output power.

Technical Specifications

Programmed Output Voltage (Mode 1)
Output Voltage Range: -2V to +2V
Current Range: -10 mA to +10 mA
Resolution: 1 mV (1:4000)
Accuracy: ±(0.1% of value + 0.1% of range)
Output Impedance: 0.1Ω (or 1 mV/10 mA)

Programmed Output Voltage (Mode 2)
Output Voltage Range: -9V to +9V
Current Range: -20 mA to 20 mA
Resolution: 10 mV (1:4000)
Accuracy: ±(0.1% of value + 0.05% of range)
Output Impedance: 0.1Ω (or 1 mV/10 mA)
Output Voltage (max): +20.5V

Programmed Output Current (Mode 3)
Output Current Range: ±20 mA
Current Range: ±9V
Resolution: 10 µA (1:4000)
Accuracy: ±(0.1% of value + 0.05% of range)
Output Impedance: 0.1 µA/V
Output Admittance: 0.1 µA/V/K

General Specifications

Response Time: Approximately 50 ms after master unit
Setting Time: Approx 40 ms
Display Module: Optional display adapter PM 2190 shows:
- Mode
- Output voltage
- Output current

Current Consumption from System Supply: Max 325 mA, typical 250 mA

PM 2160 Temperature Unit for Pt 100

The PM 2160 offers temperature measurement with Pt 100 sensors from -200°C to +850°C to a resolution of 0.1°C. The result is linearized and output in ASCII for direct input to a system controller.

Results can be compared to preset high and low limits. If they are exceeded, a warning is sent to the controller and the respective relay in the unit is activated.

Technical Specifications

Configuration: Single 4-wire connection to Pt 100 sensor, current source/voltage input float w.r.t. main system
Operating Mode: Fixed
Measurement Range: -200°C to +850°C, resolution 0.1°C
Overload Indication: 999.9°C
Accuracy (not incl. sensor): ±(0.1% of reading +0.5°C) (-100°C to 850°C) ±(0.1% of reading +1°C) (±200°C to 100°C)
Temperature Coeff: ±(0.01% of reading +0.1°C)/°C

System 21

Common Mode Voltage: Floating sensor connection max 30V rms or 42V peak or dc w.r.t. system 9/send
Measurement Time: 0.5s (-50°C to +250°C) 0.63s max at -200°C, 1.25s max at +850°C
Measurement Trigger: Free running or triggered by systems bus

Limit Relay Output
Maximum Switching Voltage: 30V ac or 42V dc
Maximum Switching Current: 0.5A
Maximum Switching Power: 10W
Maximum Contact Resistance: 100 mΩ
Limit Parameters: The output can be compared with a high and low limit (+850°C or -200°C). Out of limit generates an SRQ signal for the controller, and activates high or low relays, accessible on the rear panel.
Terminals: 37-pin female D-type connector
Display Module: Optional PM 2190 shows trigger mode and ready stauts, measured value (or overload), and high and low limit value
Current Consumption from System Supply: Max 100 mA

PM 2150 User Adaptable Unit

The User Adaptable Unit allows the connection of a user-build function to the IEEE-488 bus. For this reason, fixing facilities, power supply and a connector for a standard Eurocard are provided in the unit. For interfacing to the user-build function, 16 I/O lines are available

Technical Specifications

Configuration: Two groups of 8 I/O lines, read or written in groups, and with a common return
Signal Levels: CMOS 5V compatible with 10 kΩ pull-up
Power Supply: A maximum of 200 mA at 5V ±5% is available for user-build circuitry
Use of I/O Lines: The 16 I/O lines can be used in any I/O line configuration
Reference Facility: A matching state of I/O lines can be detected by reference setting. The corresponding warning flag can be used to generate a service request message. The reference pattern can consist of: "don't care", low, high or "changing state" bits.

Timing
Response Time on Read or Write Command: <10 ms
Minimum Pulse Width to Set "Match Reference" Flag: 10 ms
Control Commands: All I/O lines can be set or read individually or in combination in binary, decimal, hexadecimal or ASCII code. The reference can be set in binary, decimal or hexadecimal codes ("don't cares" and "change state" in binary code only).

Display Module: The optional Display Module shows:

- Synchronization mode and ready status
- Data sent to the I/O lines
- Status of the I/O lines

Current Consumption from System Source: <250 mA

Accessories

PM 2190 Display Module

The PM 2190 Display Module has an 8-digit LCD to show programmed modes and settings of the Slave Units during debugging. The module can be plugged onto the front panel connector of each Slave Unit. (The parameters shown on the Display Module are specified for each Slave Unit.)

PM 2191 Terminal Adapter

The PM 2191 Terminal Adapter adds a screw-connection terminal to Slave Units which have a 37-pin D-type terminal.

PM 2192 Extension Cable Set

A set of flat cables and connectors enabling the System 21 internal bus to be extended so that units can be used at different places in a rack. The set contains:

- 1M flat cable with an internal bus connector at one end
- 3 additional connectors

PM 2193 19" Rack Mount Kit

This rack mount kit allows up to 8 System 21 units or 4 System 21 units plus one PM 2525/34/35 DMM to be mounted in a standard 3E high rack unit. Wiring for interconnection of the units is provided as standard.

PM 2194 Blank Panels (Rack Mount Kit)

The PM 2194 provides blank panels for the PM 2193 Rack Mount Kit. The rack mount kit holds up to eight System 21 modules. If less than eight modules are used the blank panels will cover any of the empty locations in the rack mount kit.
The PM 2194 provides enough pieces to cover seven locations of the rack mount kit, if only one System 21 module was used.

PM 2198 Additional Power Supply Unit

In extensive systems requiring more current than the 750 mA capacity of the PM 2101 Master Unit, additional PM 2198 Power Supply Units can be connected in parallel. Each additional PM 2198 provides an additional 750 mA.

Technical Specifications
Power: 110V, 120V, 220V or 240V ac ± 10%, 50 Hz or 60 Hz
Power Consumption: 16 VA max
Safety: Class II acc to IEC 348
Secondary Power Supply for Slave Units: 7.5V (at full load) to 16V (unloaded)
Maximum Current Load: 750 mA

Ordering Information

Model

PM 2101/02n Master Unit

Switches
PM 2120/02 Universal Switch
PM 2121/02 Low-Level Switch
PM 2122/02 50Ω Coaxial Switch
PM 2124/02 High Current Switch

Digital I/O
PM 2130/02 Digital I/O Unit
PM 2131/02 Digital Input Unit
PM 2132/02 Digital Output Unit

Data Acquisition & Custom Units
PM 2140/02 Analog Input Unit
PM 2141/02 Analog Output Unit
PM 2150/02 User Adaptable Units
PM 2160/02 Pt-100 Temperature Unit

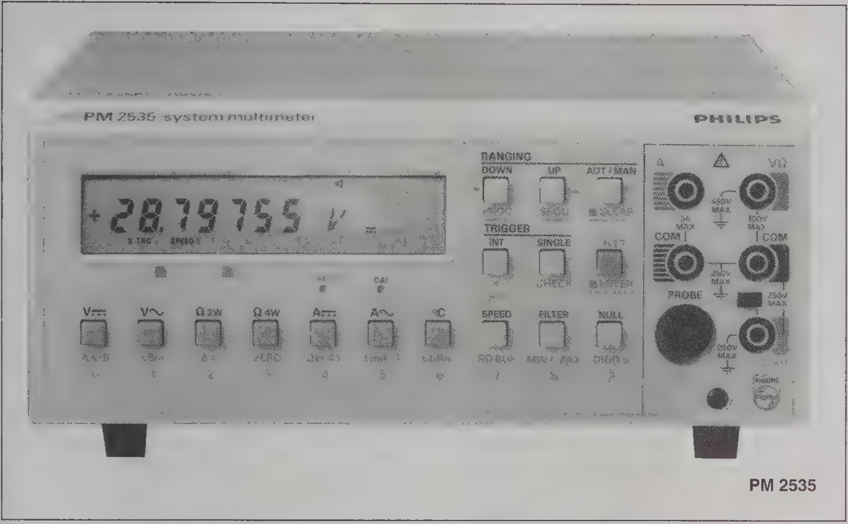
Accessories
PM 2190/02 Display Module
PM 2191/01 Terminal Adapter (qty: 3)
PM 2191/10 Teminal Adapter (qty: 1)
PM 2192/01 Extension Cable Set
PM 2193/03 Rack Mount Kit
PM 2194/02 Blank Panel for Rack Mount Kit
PM 2198/02n Additional Power Supply Unit

The n' indicates the required line cord. To select your line cord substitute the n' by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

PM 2534 & PM 2535

GPIB
IEEE-488

RS-232



PM 2535

PM 2534 & PM 2535 GPIB/IEEE-488 Instrumentation System

- $3^1/_2$ to $6^1/_2$ digits
- 100 nV resolution
- 100 measurements/second
- GPIB/IEEE-488 interface standard
- Front or rear inputs
- Scanner extension

The PM 2534 and PM 2535 GPIB Instrumentation Systems cover a broad range of applications. While both instruments are suitable for a wide range of general purpose measurements, the PM 2535 offers additional advanced functions for applications demanding data gathering and fast measurement collecting and processing.

Basic Features

Both the PM 2534 and PM 2535 offer seven measurement functions, front or rear inputs and $6^1/_2$ digit guarded sensitive measurements or up to $3^1/_2$ digit high speed measurements. The units can operate in scan mode under external control via the GPIB/IEEE-488* interface.

Extra Capabilities of the PM 2535

As well as the above features, the PM 2535 has built-in data collection, advanced control facilities and calculations including Ax + B, Δ%, dBm and relative measurements. Maximum and minimum values can be stored over a time interval, and warnings can be given if specified limits are exceeded. Burst mode provides up to 150 measurements/sec. Sequence programming allows repetition of the same measurement cycle; thus when combined with System 21 modules, allows the PM 2535 to act as a data logger with no need for dedicated computer control.

Computer Control

The PM 2534 and PM 2535 can be controlled via the GPIB or RS-232C interface. The PM 2535 also offers the following system capabilities: 10 functional measurement set-ups can be programmed including processing such as Ax + B, dBm or zero-set. With the SEQUENCE function these 10 functional set-ups can be made automatically and sequentially. When combined with the burst mode, the measurements made can be stored in the PM 2535 until read by the computer, thus freeing the computer to handle other routines.

Controlling System 21 Modules

Many system applications demand measurements to be made at a number of different points and require large and expensive scanners. But with the PM 2534 and PM 2535, System 21 can be added to any GPIB application to provide a modular and cost-effective solution to system switching. Both the PM 2534 and PM 2535 have a System 21 Master Unit built-in, enabling them to control any System 21 switch units.

System 21 Slave Units connect to the internal bus connector on the rear of the PM 2534 or PM 2535 with a PM 2192 Extension Cable Set. In addition, control commands are accepted via the PM 2534 or PM 2535 GPIB interface and retransmitted to the System 21 internal bus, eliminating the need for costly interfaces, cables and power supplies.

Controlling System 21 without an Instrument Controller

The PM 2535 also has the capability to control System 21 Slave Units without the need of an instrument controller. Through the SEQUENCE function, the PM 2535 can create a 99 step program. Each step of the program is associated with one of ten functional DMM set-ups. Both the SEQUENCE program and the 10 functional DMM set-ups are stored in non-volatile memory in case of power loss. For more information on System 21, see page 307.

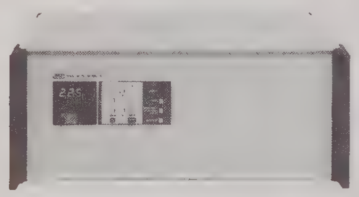
For Technical Specifications and Ordering Information for the PM 2534 and PM 2535 see page 63.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

2205A

GPIB IEEE-488

Limited Availability



(NSN 6625-01-266-6979) **PM 2205A**

2205A Controller/Scanner

- Plug-in modules that expand the versatility of the 2205A
- Channel expansion (up to 1000)
- Matrix latching
- Low level and thermocouple scanning
- Two-wire or four-wire resistance scanning

Versatile Switching, Latching, Scanning

The microprocessor-based 2205A Switch Controller offers a wide variety of switching, scanning, and matrix-latching capabilities for applications in production testing, process monitoring, process automation, calibration, etc.

The 2205A may be operated or programmed from the front panel to perform periodic switching operations. Or it may be directed remotely in a system compatible with GPIB/IEEE-488* to perform complex switching operations.

Specifications

2205A Specifications

Control: Manual, panel-programmed scan, or via IEEE-488 Interface
Panel Controls: Select channels to be scanned, actuated, or latched. Scan rate selectable in 0.1 second increments from 0.2 seconds to 3.3 seconds per channel using behind-the-panel control
Switch-Module Slots: Ten, expandable to 100 using several 2201A (12-slot) or 2202A (10-slot) Extender Chassis
Display: 3-digit LED. Shows active channel number. Also shows assigned address (using IEEE-488 Interface) at time of power-up
Trigger Output: Rear panel BNC connector. TTL level. Adjustable delay. To trigger measurements following moments when switching occurs
Analog Output: To digital multimeter via rear panel output connector. Guarded 2-wire or guarded 4-wire connections. Common-mode voltage 170V dc or peak ac
Other Inputs and Outputs: Via module connectors included with modules

2201A Specifications

Switch-Module Slots: 12 in each 2201A. Up to 100 slots (1000 channels) per system. One or more 2201A Extender Chassis may be connected to a 2205A via a six-foot cable supplied with each 2201A. Power and control for the modules is supplied by the 2205A.

Option Specifications

Actuator Control Module (-100)

Relays: Five, SPDT
Switching Time: 20 ms*
Contact Rating: 1A maximum at up to 26V dc or 30V rms ac. 3A fuse in each common line
Connectors: Screw terminals, three lines per relay

Matrix Latching Module (-200)

Relays: Eight, latching, DPST with unswitched guard, break-before-make
Switching Time: 8 ms*
Rating: 40 mA maximum to 170V dc or peak ac, max
Bandwidth: DC to 1 MHz (±0.1 dB) into 600Ω to 1 MΩ load
Thermal Offset: <10 μV
Configurations: One 2x4 matrix, two 1x4 matrixes, or one 1x8 matrix
Connectors: Screw terminals, three lines per relay

General-Purpose Scanning Module (-300)

Relays: Ten, reed type, DPST with unswitched guard
Scan Rate: 125 channels per second, max*
Rating: 40 mA maximum. A 0.5A fuse in each input line
Thermal Offset: <10 μV
Connectors: Screw terminals, three lines per relay

Low-Level Scanning Module (-600)

Relays: Ten, reed type, 3 PST, switched guard
Scan Rate: 80 channels per second, maximum*
Rating: 15 mA maximum to 35V peak
Reference Junction Output: 540 mV at 25°C
Thermal Offset: <1 μV
Connectors: Screw terminals on isothermal block to minimize temperature differences between terminals when scanning thermocouples. Reference junction temperature-sensing circuit on isothermal block provides automatic compensation to thermocouple output signals.

Four-wire Ohms (-400) (-300 plus -600)

Two modules per option, used in adjacent slots. Switch both current-source and voltage-sense connections for precision resistance measurements. Specifications for current sourcing are the same as for Option -300. Specifications for voltage sensing are the same as for Option -600, except reference junction temperature sensing circuits are not available. For applications requiring more than 50 four-wire ohm circuits, the 2200A-7000/AU adapter and pairs of 2201A Extender Chassis are required.

**These times are 2205A times and do not necessarily reflect system specs*

General Specifications

Temperature: 0°C to 50°C, operating; -55°C to +75°C, non-operating
Relative Humidity: ≤80% to 40°C, operating
Safety: Designed to comply with ANSI C39.5, IEC 348, and CSA Bulletin 556B
Power: 100, 120, 220, or 240V ac ±10%, 50 Hz to 60 Hz, selectable from rear panel. 25W maximum
Size: 17.8 cm H x 43.2 cm W x 44 cm D (7 in H x 17 in W x 17.4 in D)
Weight: 7.1 kg (15.6 lb)

Ordering Information

Models

2205A Switch Controller, incudes IEEE-488 Interface
2201A Extender Chassis

Included with Instrument

2205A: Manual, power cord, 3-foot Y8076 analog output cable for 8505A, 8506A, or 8520A DMM; **2201A:** Manual, six-foot cable for connecting to 2205A

Options

-100 Actuator Control
-200 Matrix Latching
-300 General-Purpose Scanning
-400 4-Wire Ohms Scanning
-600 Low-level Scanning

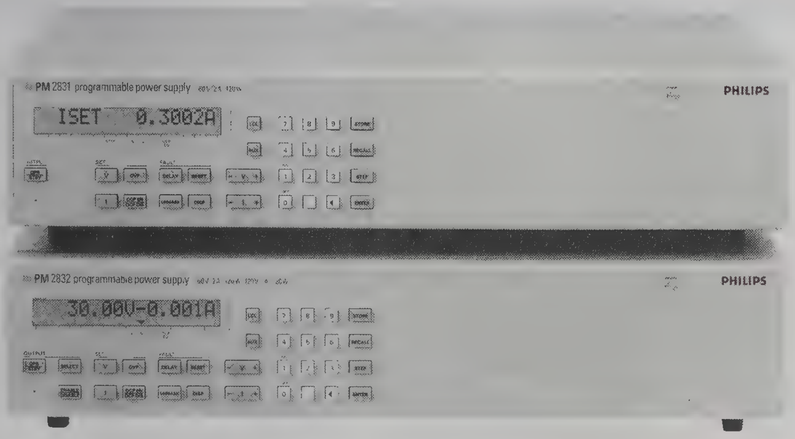
Accessories (Also see Section 19)
2205A-008K Low-Level Connector
2205A-009K General-Purpose Connector
2205A-110K Actuator Card
2205A-210K Matrix Latching Card
2205A-610K Low-Level Scanner Card
2200A-7000/AU Multi-Channel 4-Wire Ohms Adapter
Y8021 Cable for IEEE-488 Bus, 1m
Y8022 Cable for IEEE-488 Bus, 2m
Y8023 Cable for IEEE-488 Bus, 4m
Y8076 Analog Interface Cable (included w/2205A) 3-foot
M07-205-600 7" Rack Mount Kit
M00-260-610 18" Rack Slides (needs M07-205-600)
M00-270-610 20" Rack Slides (needs M07-205-600)
M00-280-610 24" Rack Slides (needs M07-205-600)

** -7001 and -7002 both required with 2202A*

** The terms GPIB and IEEE-488 may be used inter-changeably throughout this catalog.*

Programmable Power Supplies

GPIB IEEE-488


PM 2831 programmable power supply
PHILIPS
ISET 0.3002A
PM 2832 programmable power supply
PHILIPS
30.000V-0.001A

PM 2831 & PM 2832

PM 2800 Family of Programmable Power Supplies

- Single, dual and triple output versions
- 60W or 120W output power options
- Autoranging power modules for maximum versatility with voltage and current
- Linear power modules for current source/sink capability (PM 2831 & PM 2832 series)
- GPIB/IEEE-488.2 interface with SCPI protocol for easy programming
- Internal memory stores 99 voltage & current settings
- Built-in metering (readback) for voltage and current
- Constant voltage, constant current, overvoltage/overcurrent protection modes

The Fluke line of Programmable Power Supplies was created with automated testing in mind. The GPIB/IEEE-488* interface, output power module and output metering facilities are built in, taking up only 2 engineering units of rack height. The full rack width models come equipped with rack mount ears for easy installation in a standard 19" rack.

The front panel allows full access to all instrument functions, including voltage and current readback.

A sequence of front panel settings can be created with the AUTOSTEP mode, quickly creating an automated test pattern of user-defined voltages and currents with no need for a controller.

The optional front panel output gives the user easy access to both the power output connections and the sense lines; great for prototyping and temporary set-ups.

Versatile Power

Fluke now offers two types of power modules: **Autoranging** power modules for superior current and voltage versatility. The PM 2811, PM 2812 and PM 2813 offer autoranging in 60W and 120W up to 180W per mainframe.

Linear power modules for current source/sink capability. The new PM 2831 and PM 2832 family offers linear power modules from 120W up to 240W per mainframe.

Voltage Source or Current Source

The power supply can act either as voltage source or as current source, depending on the load conditions and the selected values of voltage and current.

Versatile Programming

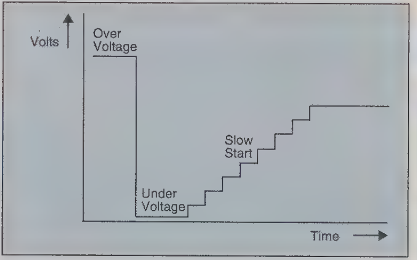
Every model comes equipped with the GPIB/IEEE-488.2 interface which supports the Standard Commands for Programmable Instruments (SCPI). By conforming to this industry standard in programming, the task of creating and supporting application programs is made easier.

The front panel interface is more than just a readback facility. From the front panel the user can access all of the functions that are implemented in GPIB.

Internal Memory and Autostep

Up to 99 settings of voltage and current can be stored and recalled from the internal non-volatile memory (valid per output). The last instrument settings are automatically stored on power down.

The STEP function allows the voltage and current settings stored in the internal memory to be recalled successively, and to be activated if the supply is in Operated Mode, by pressing a single key. A repetitive pattern can be created using AUTOSTEP to sequence front panel settings at a user-defined rate.



The figure shows a voltage pattern for testing over and undervoltage and slow start-up to a device under test, using AUTOSTEP.

The power supplies are equipped with external trigger lines which can be used to recall voltage and current settings from the internal memory. This allows accurate synchronization with other equipment and results in less GPIB traffic.

Extensive Protection Features

To protect your device under test, an extensive set of protection features has been included. Over Voltage and Over Current limit values can be set by the user. When a limit value is reached, power is removed from the outputs within only a few milliseconds.

Voltage and Current are constantly monitored by a separate readback circuit with its own sense lines for measuring voltages directly at the load. A programmable delay feature allows protection to ignore short term overloads, such as current surges during a turn-on sequence. The Coupled Protection feature ensures that an overload in one output will shut down all other outputs, simultaneously, an important feature for applications requiring positive and negative balanced voltages such as operational amplifiers. The power supplies continuously monitor themselves for internal over-temperature conditions. Output power

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**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

can be turned on and off using the Operate/Standby mode which can be selected with a front panel key or is programmable via the GPIB interface.

Easy Calibration

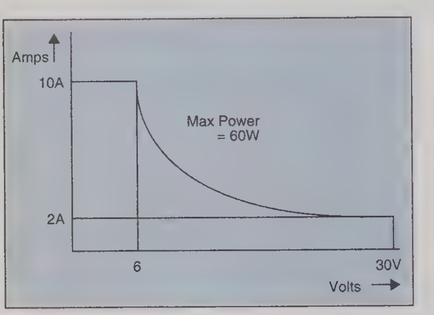
Closed case calibration means the power supply does not have to be removed from the rack for calibration. A calibrated multimeter and a load are all that is required. Access to the calibration mode is protected with a user-defined password.

Reliability You Expect

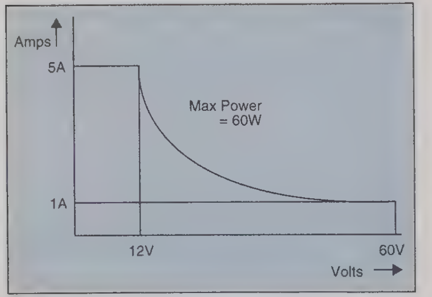
Reliability of power supplies is of extreme importance. The Fluke programmable power supplies, with extensive internal self-monitoring, device protection features and a generous amount of cooling, are designed for years of trouble-free service.

PM 2811/12/13 Autoranging Series Programmable Power Supplies

- Single, dual and triple output versions.
- 60W, 120W Power output options.
- Autoranging for maximum versatility with voltage & current



Autoranging Curve for 30V/10A/60W Power Module



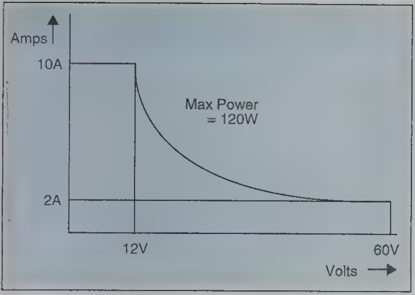
Autoranging Curve for 60V/5A/60W Power Module

Specifications

Technical Specifications

OUTPUT			
Power	60W	60W	120W
Voltage	30V	60V	60V
Current	10A	5A	10A
Accuracy			
Voltage	0.04% + 10 mV	0.04% + 20 mV	0.04% + 20 mV
Current	0.1% + 50 mA	0.1% + 25 mA	0.1% + 50 mA
OVP	0.5% + 150 mV	0.5% + 250 mV	0.5% + 250 mV
PARD (DC to 20 MHz)			
CV (pp/rms)	15 mV/3 mV	30 mV/6 mV	30 mV/6 mV
CC rms	10 mA	10 mA	10 mA
Source Effect (line ±10%)			
Voltage	0.01% + 2 mV	0.01% + 2 mV	0.01% + 2 mV
Current	0.02% + 2 mA	0.02% + 2 mA	0.02% + 2 mA
Load Effect (load change 10% to 90% or 90% to 10%)			
Voltage	0.01% + 5 mV	0.01% + 5 mV	0.01% + 5 mV
Current	0.02% + 5 mA	0.02% + 5 mA	0.02% + 5 mA
Long Term Drift			
Voltage	0.04% + 5 mV	0.04% + 5 mV	0.04% + 5 mV
Current	0.05% + 10 mA	0.05% + 10 mA	0.05% + 10 mA
Programming Resolution (12 bit)			
Voltage	7.5 mV	15 mV	15 mV
Current	2.5 mA	1.25 mA	2.5 mA
OVP	7.5 mV	15 mV	15 mV
READBACK			
Resolution			
V and I	12 bit	12 bit	12 bit
Accuracy			
Voltage	0.05% + 25 mV	0.05% + 50 mV	0.06% + 50 mV
Current	0.1 % + 30 mA	0.1 % + 15 mA	0.2 % + 30 mA
DYNAMIC OPERATION			
Load Transients	ΔI = 1A*	ΔI = 0.5A**	ΔI = 0.5A***
Settling Band	50 mV	50 mV	50 mV
Overshoot	150 mV	150 mV	150 mV
Recovery Time	1 ms	2 ms	2 ms
Programming Response Time			
T_{rise}	100 ms	200 ms	200 ms
T_{rise} (no load)	50 ms	100 ms	100 ms
T_{fall}; (V max to 1V)	100 ms	200 ms	200 ms
T_{fall} (no load); (V max to 1V)	250 ms	500 ms	500 ms
SENSE CAPABILITY			
Minimum Voltage per Lead	0.25V	0.25V	0.25V

All regulations are + or - the values listed * *(1A to 10A)* ** *(0.5A to 5A)* *** *(1A to 10A)*

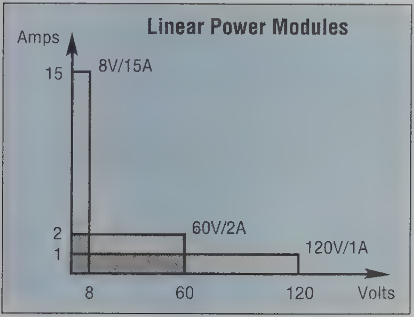


Autoranging Curve for 60V/10A/120W Power Module

PM 2831/32 Linear Series Programmable Power Supplies

- Single and dual output models.
- Low ripple and noise.
- Fast up and down programming.
- Current source/sink capability.

The PM 2830 series can sink as well as source current. Because the current sink level is programmable, the power supply can act as an electronic load.



Technical Specifications (cont.)

OUTPUT			
Power Voltage Current at 40°C at 45°C at 50°C	120W 8V ±15A +12.5A/-15A +10A/-15A	120W 60V ±2A ±2A ±2A	120W 120V ±1A ±1A ±1A
Accuracy			
Voltage Current (+ and -) OVP	0.04% + 4 mV 0.24% + 8 mA 0.04% + 4 mV	0.04% + 15 mV 0.04% + 0.5 mA 0.04% + 15 mV	0.04% + 30 mV 0.04% + 0.25 mA 0.04% + 0.30 mV
PARD (DC to 20 MHz)			
CV (pp/rms) CC rms	4 mV/1 mV 15 mA	6 mV/1 mV 2 mA	6 mV/1 mV 2 mA
Source Effect (line ±10%)			
Voltage Current	1 mV 4 mA	2 mV 1 mA	2 mV 0.5 mA
Load Effect (load change 10% to 90% or 90% to 10%)			
Voltage Current	1 mV 4 mA	2 mV 1 mA	2 mV 0.5 mA
Long Term Drift			
Voltage Current	0.02% 0.02%	0.02% 0.02%	0.02% 0.02%
Programming Resolution (12 bit)			
Voltage Current OVP	2 mV 3.75 mA 2.5 mV	15 mV 0.5 mA 15.5 mV	30 mV 0.25 mA 30.5 mV
READBACK			
Resolution			
V and I	12 bit	12 bit	12 bit
Accuracy			
Voltage Current (+ and -)	0.05% + 4 mV 0.05% + 8 mA	0.05% + 15 mV 0.05% + 1 mA	0.05% + 30 mV 0.05% + 0.5 mA
DYNAMIC OPERATION			
Load Transients	ΔI = 7.5A	ΔI = 1A	ΔI = 0.5A
Settling Band Overshoot Recovery Time	4 mV 100 mV 100 µs	30 mV 100 mV 100 µs	60 mV 100 mV 100 µs
Programming Response Time			
T_{rise}/T_{fall} no load T_{rise}/T_{fall} Overshoot (max.)	500 µs 1 ms @ 7.5A 300 mV	500 µs 1 ms @ 1A 300 mV	500 µs 1 ms @ 0.5A 300 mV
Source/Sink			
Switching Time Source/Sink Level Hysteresis	1 ms 0.6V 150 mV	1 ms 0.6V 150 mV	1 ms 0.6V 150 mV
SENSE CAPABILITY			
Minimum Voltage per Lead	<4V: 2V >4V: $(8-V_{set})/2$V	1V	1V

All regulations are + or - the values listed

Programmable Power Supplies

General Specifications

Safety

IEC-348, class 1: PM 2811, PM2812, PM 2813
IEC 1010-1: PM 2831, PM 2832
For all models: VDE 0411, CSA-C22.2 No. 231, UL 1244

EMC

Emission: VDE 0871; CISPR 11
Susceptibility: IEC 801

Environmental Data

MIL-T-28800D, Type III, Class 5, Style E
Operating Temp.: 0°C to 50°C
Storage Temp.: -20°C to +70°C

Supplemental Characteristics

Isolation: 240V above ground

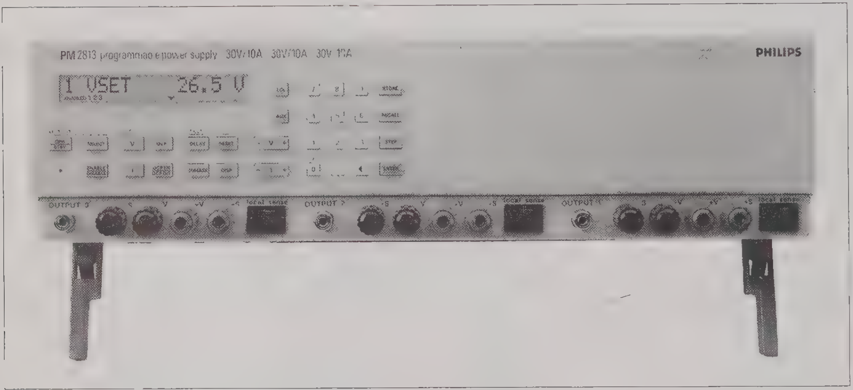
Mechanical Data

Height: (excl. feet): 87 mm (3.43 in)
Feet: 18 mm (0.71 in)
Width: For PM 2811 210 mm (8.27 in);
For PM 2812, PM 2813, PM 2831 and PM 2832 420 mm (16.54 in)
Depth: 381 mm (15.0 in)
Weight: For PM 2811: 5.5 kg (12 lb);
For PM 2812 and PM 2813: 9.5 kg (21 lb)
For PM 2831 10 kg (22 lb) and PM 2832 14 kg (31 lb)

Power Requirements

Line Voltage: 115V ac ±10%;
230V ac ±10%
Line Frequency: 50 or 60 Hz
Power Consumption:
PM 2811: 1.4A/110V, 0.8A/220V
PM 2812: 2.6A/110V, 1.4A/220V
PM 2813: 3.7A/110V, 2.0A/220V
PM 2831: 2.4A/115V, 1.2A/230V
PM 2832: 4.8A/115V, 2.4A/230V
at maximum load

Operator's manual and line cord included with instrument.



Front Panel Output Connectors

These are available for any power supply in the PM 2800 family and must be ordered factory installed only.

The part number of each power supply ordered with front panel outputs is as follows:
PM 28xx/x5x

Example

PM 2811/053 Single output, 30V/10A/60W with front panel connectors, US version.

Ordering information

Autoranging Power Supplies			
Outputs & Models	30V 10A, 60W	60V 5A, 60W	60V 10A, 120W
Single			
PM 2811/0*n	1		
PM 2811/1*n		1	
Duals			
PM 2812/0*n	2		
PM 2812/1*n		2	
PM 2812/2*n	1	1	
PM 2812/3*n	1		1
PM 2812/4*n		1	1
Triples			
PM 2813/0*n	3		
PM 2813/1*n		3	
PM 2813/2*n	2	1	
PM 2813/3*n	1	2	

Linear Power Supplies			
Outputs & Models	8V ±15A, 120W	60V ±2A, 120W	120V ±1A, 120W
Single			
PM 2831/0*3		1	
PM 2831/1*3			1
PM 2831/2*3	1		
Duals			
PM 2832/0*3		2	
PM 2832/1*3			2
PM 2832/2*3		1	1
PM 2832/3*3	2		

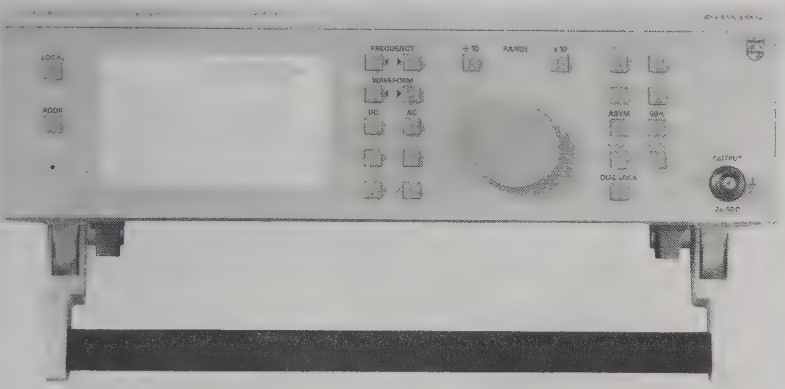
** 1 = Outputs rear*
5 = Outputs front

The n' indicates the required line cord. To select your line cord substitute the n' by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

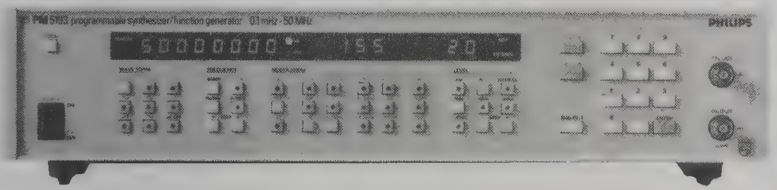
Accessories

PM 2392/01 Cable Set for external trigger line
PM 9280/04 Rack Mount Kit for two PM 2811's

Signal Sources

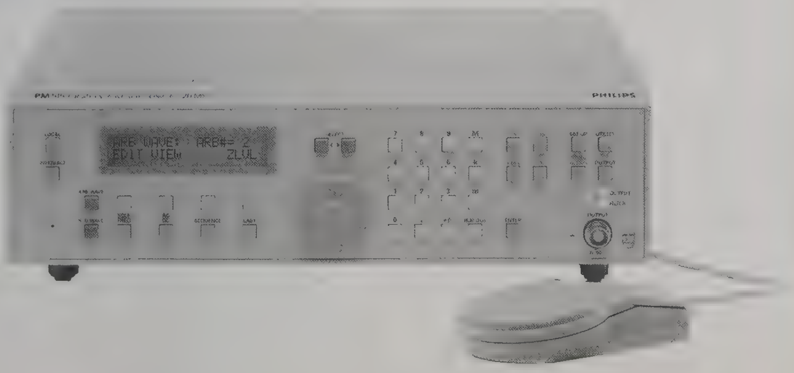


PM 5138 Page 335



PM 5193 Page 326

EW



PM 5150 Page 321

From ultra high-frequency L-Band applications to low-frequency mechanical testing, Fluke offers signal sources to fit your budget and performance needs. Fluke sources include:

- RC + Function Generators (0.1 Hz to 50 MHz)
- Pulse Generators (0.1 Hz to 125 MHz)

The PM 5138 and PM 5139 offer the convenience of menu-driven operation, with a wide range of waveforms. The PM 5139 features a 20 MHz range plus an internal modulation source programmable from 1 mHz to 100 kHz for AM, FM, Burst, Gated, and PSK modulation. The PM 5193 offers superb systems performance: 50 MHz range, eight digit resolution, eight waveforms and five modulation modes.

The PM 5150 Arbitrary Waveform Generator is our latest addition to the Fluke generator family. Choose from 20 standard waveforms or create your own custom waveform with the powerful front panel editor or via the IEEE-488.2 interface. The deep 32k waveform memory can be segmented into as many as 100 separate waveforms. The optional sequence generator links and repeats selected waveforms to allow complex patterns to be generated with a minimal amount of waveform memory.

Selection Guide Page 320
Arbitrary Waveform Generator Page 321
Function Generators Page 326
Pulse Generators Page 351
TV & Video Generators Page 359

Selection Guides

Function Generators

Models	Frequency Range	Setting Error	Output V p-p (Hi Z Load)	DC Offset	Waveforms							Variable Duty Cycle	Output Character-istics			Sweep				Burst	Single	Gating	Int Ext		GPIB/ IEEE-488	Page Number
	Hz-MHz				∿	⊓	∧	1) ⊓	⟋	ARB	⌒		600Ω	50Ω	TTL	Linear Int	Linear Ext	Log Int	Log Ext				AM	FM		
PM 5132	0.1-2	2%	30	•	•	•	•	•				•	•	•	•	•	•									347
PM 5133* **	0.01-2	3%	20	•	•	•	•	•				•	•	•	•	•	•	•	•	•	•			•		345
PM 5134*	0.001-20	5%	20	•	•	•	•	•				•	•	•	•	•	•			•	•		•	•		342
PM 5138	0.0001-10	2 ppm	20	•	•	•	•	•	1) •	Opt		•		•	•	•	•	•	•	•	•	•	•	•	Opt	335
PM 5139	0.0001-20	2 ppm	20	•	•	•	•	•	1)•	Opt	•	•		•	•	•	•	•	•	•	•	•	•	•	Opt	335
PM 5190X	0.001-2	1 ppm	20	•	•	•	•							•	•								•		•	333
PM 5191	0.0001-2	1 ppm	30	•	•	•	•		•					•	•							•	•	•	•	326
PM 5192	0.0001-20	1 ppm	20	•	•	•	•		•					•	•	•	•	•	•			•	•	•	•	326
PM 5193**	0.0001-50	1 ppm	20	•	•	•	•	•	•		•			•	•	•	•	•	•	•	•				•	326

*PM 5134 also provides crystal mode and crystal AM mode

**PM 5193 includes 3 ns pulse generator

1) Positive and negative

***PM 5133S adds audio sweep output

Pulse Generators

Models	Transi-tion Time	Duration	Max Fre-quency	Operating Modes			External Control					Outputs					Pg
				Square Wave	Double Pulse	Counted Burst	External Trigger	Var Trigger Level	Var Delay	External Duration	External Gate	Amp (50Ω load)	Offset (50Ω load)	Pulse Outputs	Sync (Clock)	GPIB/ IEEE-488	
PM 5786	2 ns to 0.1s	3.5 ns to 100 ms	125 MHz	•	•	Opt	•	•	8 ns to 100 ms	•	•	0.2V to 5V	-2.5V to +2.5V	A,B	•		355
PM 5712	4 ns	10 ns to 100 ms	50 MHz	•	•		•		10 ns to 100 ms	•	•	0.2V to 10V	-5V to +2V	A	• (2 outputs)		357
PM 5715	6 ns to 0.5s	10 ns to 100 ms	50 MHz	•	•		•		10 ns to 100 ms	•	•	0.2V to 10V	-5V to +2.5V	A	• (2 outputs)		357

Arbitrary Waveform Generator

Model	Maximum Sample Rate	Memory Depth	Amplitude Resolution	Standard Waveforms	Output LP Filter	Output Impedance	Maximum Amplitude	Sequence Generator	Pg
PM 5150	20 MS/s	32k	12 bits	20	7 MHz	50Ω	10V, 50Ω load	option	321

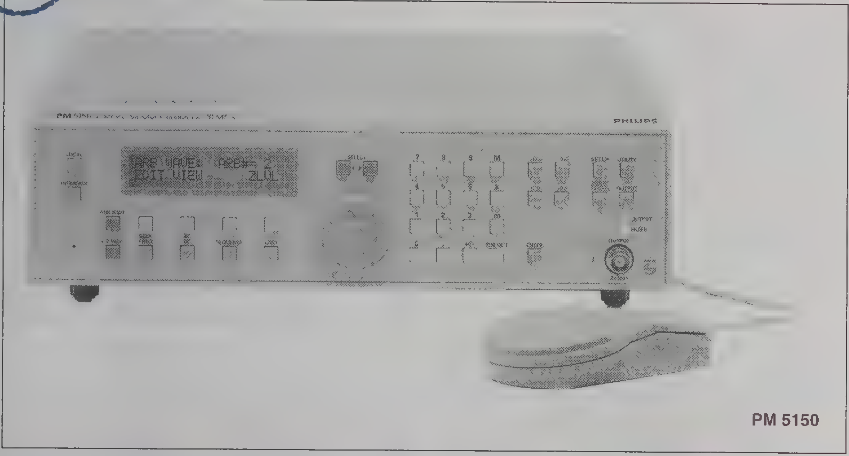
TV and Video Pattern Generators

Model	Color and Monochrome TV	PAL	NTSC	SECAM	VCR	Video Monitors	Page
PM 5414V		•	•		•	•	359
PM 5415	•	•	•		•	•	361
PM 5418	•		•	•	•	•	361

PM 5150

GPIB
IEEE-488

RS-232



PM 5150

PM 5150 20 MS/s Arbitrary Waveform Generator

- Versatile waveform creation and editing facilities
- 20 standard waveforms
- Deep 32K waveform memory allows generation of up to 100 waveforms
- 0.1 Sample/s to 20M Samples/s sample clock
- Digital waveform synthesis with 12-bit amplitude resolution
- Optional sequence generator links or repeats waveforms to run extended tests
- Waveform addition, subtraction and multiplication facility
- RS-232C and GPIB/IEEE-488.2 interfaces standard

The PM 5150 offers an exceptional combination of versatility and value in arbitrary waveform generation: a total of 20 standard waveforms, plus the ability to generate any desired custom waveshapes for special test and signal-simulation purposes.

32K of Waveform Memory

With 32K of non-volatile waveform memory (32,768 points), of which 31K is freely assignable, the most complex waveshapes and patterns can be created and stored for instant recall at any time. This gives the user a powerful capability to generate specific waveshapes for a virtually unlimited variety of tests and simulations, using input signals closely matching those encountered under actual operating conditions.

The generator's memory is divided into individually addressable segments, each of which can contain a separate waveform. Up to 100 segments can be defined by the user. Each segment is assigned a waveform number by means of which the waveform stored in it can be conveniently recalled whenever it is needed.

Precision Waveform Generation

All waveforms are digitally synthesized, with 12-bit amplitude resolution (4095 points) for high accuracy. The digital synthesis principle ensures high waveform quality, with low sine distortion and excellent triangle and ramp linearity. The accurate internal clock generates sample frequencies of up to 20 MS/s, covering a wide range of output signal frequencies.

Menu-Driven Display

The easy-to-read 2 x 20-character backlit display contributes to the PM 5150's ease of operation, and clearly shows all setup parameters and selected values. Selections and changes are made simply, using either the rotary edit control to scan quickly through the entire range of values, or the numeric keypad for convenient entry of precise values. The select left or right keys next to the display allow fast stepping through the displayed menu options.

Convenient Waveform Definition

Waveform definition and editing have been made exceptionally simple, thanks to the PM 5150's innovative line segment 'draw' mode and waveform construction using the optional mouse or via the front-panel keypad. This feature allows either complete waveforms to be constructed from scratch, or existing standard or user-defined waveforms to be modified as desired.

The 'Line' mode enables waveforms to be defined by drawing a series of chords from a set of anchor points, using just a few movements of the mouse or rotary control, or keypad strokes.

The alternative 'Vector' mode allows any existing waveforms to be modified. All that is necessary is to define the active waveform edit area by means of anchor points at its left and right extremities, and choose one of the three available waveform modification modes. The 'Vertex' mode allows a new waveform section to be created simply by defining a new vertex point anywhere in the active edit area; the 'Insert' mode allows direct 'cut-and-paste' replacement of the old waveform section with a new section defined by the user; and the 'Sum' mode allows a new waveform section to be summed with the existing section.

Waveform Math Operations

Additional tools for defining custom waveforms are the mathematical operations addition, subtraction and multiplication, which allow new, composite waveforms with precisely defined characteristics to be created with just a few simply controlled operations.

These operations open-up numerous possibilities to generate special test signals; for example by adding transients, by adding or subtracting signals to create tone bursts; or by multiplying two waveforms to create amplitude-modulated signals. Furthermore all these operations can be iterated multiple times, adding extra versatility.

Waveform Scaling

Another method of modifying existing waveforms is by the use of digital scaling, which allows the amplitude and offset of the waveform between the two anchor points to be changed. Digital amplitude control automatically scales - or even inverts - any waveform between the defined anchor points, while digital offset control shifts a waveform in either the positive or negative direction.

AnyWave PC Software

A waveform captured by a Fluke Digital Storage Oscilloscope can be transferred to a PC and modified using the AnyWave PC software tool for creating, capturing, and modifying waveforms, and transferring them quickly and easily to the PM 5150. You can create your own archival library of custom waveforms on your hard disk.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 5150

Alternatively, any desired waveform can be captured from a test system using a Fluke DSO and then transferred to the PM 5150 without the need for a PC.

Versatile Waveform Sequence Generation

Even more versatility is provided by the optional sequence generator, which allows any of the waveforms stored in memory - either standard or user-defined - to be concatenated without requiring additional memory space. Waveform sequences can also include loops, in which any of the stored waveforms may be repeated a large number of times. In this way, extended and repetitive test sequences far exceeding the standard memory capacity can be generated.

Programmed waveform sequences may contain as many as 1000 steps, and up to 100 programmed sequences can be defined and stored in memory. The available library of up to 100 waveforms, and the ability to define sequences in excess of a million counts per step, add up to a tremendous virtual expansion of the available memory. This facility offers an unprecedented capability to define and run complex arbitrary test patterns from a single, economic and easy-to-operate instrument.

Just a few examples of the sequences that can be generated with this feature include stepped frequency sweeps, in which single waveforms can be inserted between long, repetitive bursts of other waveforms to simulate specific duty cycle conditions; a continuous signal stream with occasional interruptions.

Choice of 20 Standard Waveforms

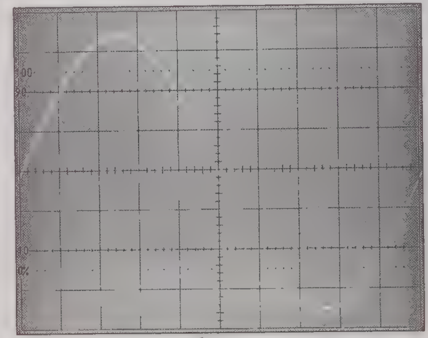
The wide choice of 20 standard waveforms gives instant access to numerous frequently required test signals. These can be used as they are, or subjected to any of the PM 5150's math, scaling and editing operations to create modified or completely new signals. In addition the standard waveforms can also be incorporated in programs created using the optional sequence generator. These standard waveforms are: sine, triangle, square, ramp (±), dc, pulse (±), exponential (±), AM, SCM, FM, lin./log. sweep, noise, sin x/x, Gaussian, haversine and circle.

Multi-Channel Operation

Reference and Sync connectors are provided for connection of multiple units to provide synchronous outputs with any desired phase offset. For example, three generators can be connected together with a 120° phase offset for simulation of a three-phase power network. The phase can be set with a resolution of 0.001°.

Standard RS-232C and GPIB/IEEE-488.2 Interfaces

The PM 5150's standard RS-232C interface enables mouse- controlled editing . The GPIB/ IEEE-488.2 interface allows the PM 5150 to be integrated into automated GPIB measurement and instrumentation systems, for example in automated testing applications such as in production-line environments. The interface enables full remote programmability of the PM 5150, together with facilities for downloading of user-defined test set-ups and routines. The IEEE-488 interface is also used for downloading of captured waveforms from a DSO.



Just select the two anchor points on the arbitrary waveform (photo 1), and the part of the waveform between these points can be manipulated.

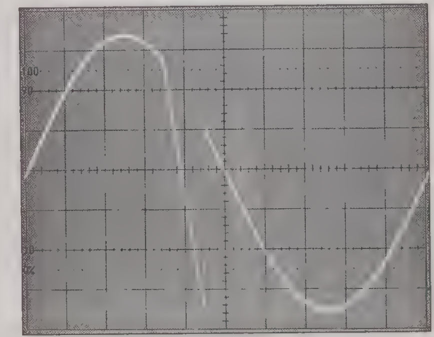


Photo 2 shows "Vector" mode editing using a cursor.

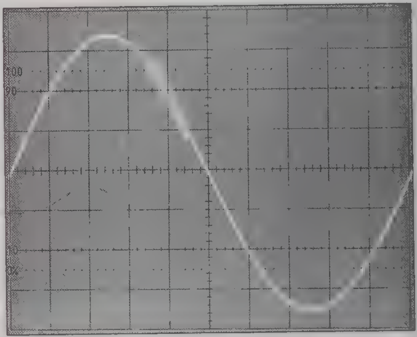


Photo 3 shows the addition of a noise signal between the anchors to a sine wave.

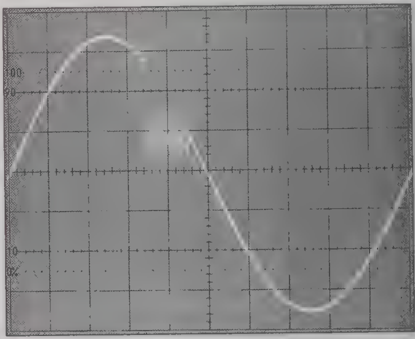


Photo 4 shows the insertion of a noise signal between the anchors.

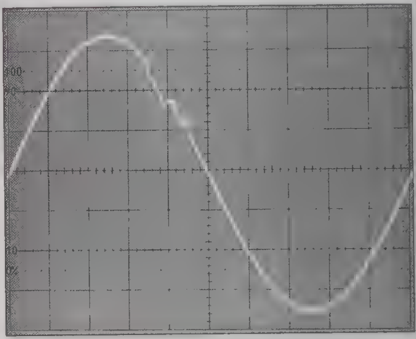


Photo 5 shows the average function of a noise signal between the anchors.

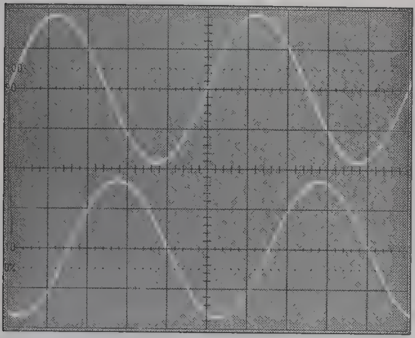


Photo 6 shows two synchronized PM 5150 arbitrary waveform generators, with variable phase setting between the two main outputs of the generators. The phase can be set with very high accuracy over the range from 0 to 360 degrees.

Specifications

Technical Specifications

Sampling Frequency

Total Range: 100 mHz to 20 MHz (50 ns to 10s per sample)

Frequency Subrange	Resolution
100.0 to 999.9 mHz	0.1 mHz
1.000 to 9.999 Hz	1 mHz
10.00 to 99.99 Hz	10 mHz
100.0 to 999.9 Hz	100 mHz
1.000 to 9.999 kHz	1 Hz
10.00 to 99.99 kHz	10 Hz
100.0 to 999.9 kHz	100 Hz
1.000 to 9.999 MHz	1 kHz
10.000 to 20.000 MHz	2 kHz

Accuracy: ±50 ppm

Amplitude

AC Voltage p-p Open Circuit

Range	Resol.	Error limits
2.00V to 20.00V	10 mV	±1% of setting ±40 mV
200 mV to 2.000V	1 mV	±3% of setting ±10 mV
20.0 mV to 200.0 mV	0.1 mV	±5% of setting ±2 mV

Front Panel Output

Output Impedance: 50Ω

Standard Waveforms

Standard Waveform Length: Freely programmable
Minimum Length: 32 points
Maximum Length: 32,736 points

Waveform	Programmable Parameters
sine	number of cycles, phase
square	number of cycles, duty cycle
± pulse	number of cycles, delay, rise, fall, high
triangle	number of cycles
± sawtooth	number of cycles, duty cycle
± Exponential	exponent
gaussian	exponent
haversine	number of cycles
circle	number of cycles, phase
sin x/x	number of cycles
noise	
lin sweep	f_{start}/f_{stop} ratio
log sweep	f_{start}/f_{stop} ratio
AM	f_c/f_m ratio, mod. depth, f_c phase, f_m phase
SCM	f_c/f_m ratio, f_c phase, f_m phase
FM	f_c/f_m ratio, mod. index, f_c phase, f_m phase

Note: "number of cycles" means the amount of cycles in the pre-defined waveform memory length
Note: the sum of the length's of all the arb's plus the length of standard waveform memory may not exceed the limit of 32,768 points.

Arbitrary Waveforms

Total Memory Length: 32,768 points
Vertical Resolution: 12 bits; 4095 levels (-2048 to +2047)
Segmentation: total memory (32K) can be divided in 100 arb's maximum
Arb Length: Each arb (1 to 100), has a freely programmable length
Minimum Length: 32 points
Maximum Length: 32,704 points

Arbitrary Waveform Editing

Editing Tools: Front panel PM 5150 or optional mouse

Editing Modes
Line: Draw a straight line between two points

Vector
Add Function: Draw a triangle between two anchors and one variable point
Sum Function: Add a second waveform between two anchors
Insert Function: Insert a second waveform between two anchors
Digital Amplitude: Vary the amplitude of the signal between the anchors
Digital Offset: Vary the offset of the signal between the anchors
Smooth Function: The signal between the anchors can be smoothed (factor 0 to 125)
Mathematics:
ARB x + ARB y = ARB z
ARB x - ARB y = ARB z
ARB x * ARB y = ARB z

Sequence Generator (Optional)

Max. Number of Sequences: 100
Max. Number of Steps in a Sequence: 1000
Max. Number of Steps in Entire Instrument Sequence File: 1000
Max. Number of Waveforms: 100
Max. Number of Burst Cycles Per Sequence Step: 1,048,575

Spectral Purity

(PM 5150 setting: 20 kHz sine wave, 20 MHz sample freq./1000 samples, filter on, 50Ω terminated)
THD + noise at:
100 mV: -60 dBc typical
1V: to -65 dBc typical
20V: to -65 dBc typical
(measured in a frequency band 0 - 80 kHz)

Waveform Rise/Fall Time

Less Than: 20 ns
(PM 5150 setting: square wave, filter off, 10V p-p at 50Ω termination)

Analog Filter

User-selectable, 7 MHz, 7th-order low-pass filter

Operation/Modulation Modes

Continuous: Output runs continuously between selected memory address locations
Triggered: Output at start point until triggered, then runs once
Gated: As 'Triggered', but output is continuous only until gate signal ends
Burst: Each trigger outputs a pre-programmed number of waveform cycles from 1 to 1,048,575
Toggled: The output wave is keyed on/off alternatingly by triggers
RTS: Front-panel button or external signal interrupts the output wave and instantly returns it to the start level. Then the wave proceeds from this level on.
Hold: Front-panel button or external signal stops waveform at present memory location while applied

Modulation Trigger Sources

Internal Programmable: 0.02s to 10s
Manual: TRIG key
External: TRIG input

Stored Settings (Non-volatile memory)

ARB Memory: 32K
Front Panel Settings: 30

Special Inputs/Outputs

External 10 MHz Reference Clock Input
Frequency: 10 MHz ±10 ppm
Level: TTL

PM 5150

Internal 10 MHz Reference Clock Output
Frequency: 10 MHz
Level: TTL

External Sample Clock Input
Maximum Frequency: 20 MHz
Level: TTL

Internal Sample Clock Output
Frequency: 0.1 mHz to 20 MHz
Level: TTL

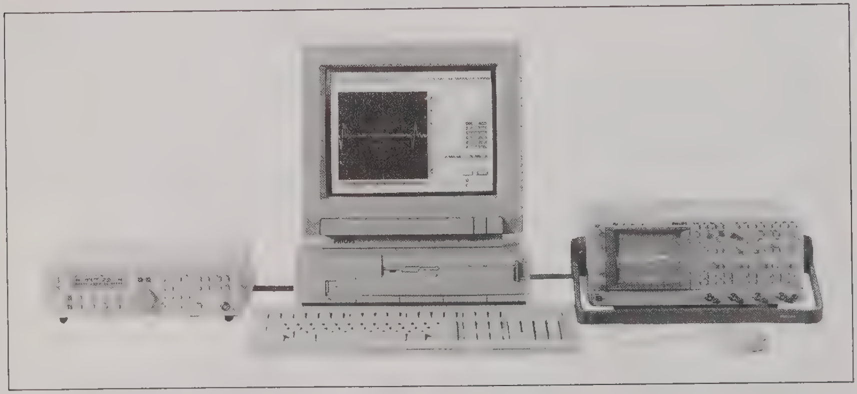
Trigger Input
Trigger input for gated, burst and toggled modes
Maximum Frequency: 20 MHz
Level: TTL

Return To Start Input
Input to reset the output signal to zero
Level: TTL

Sum Input
Input allows external signal to be added to the output
Gain: -2
Impedance: 50Ω
Minimum Frequency: 0 Hz
Maximum Frequency: 20 MHz

Hold In
Input which holds the output at current state
Level: TTL

Sync 1
Programmable TTL output
Default Mode: Pulse at the end of an ARB or STDW period
Programmable Mode: Programmable start address and pulse length
Level: TTL



Sync 2
Programmable TTL output
Default Mode: High during an ARB or STDW period
Programmable Mode: Programmable start address and pulse length
Level: TTL

Sync 3
Programmable TTL output
Default Mode: Pulse at the end of each sequence step
Programmable Mode: Programmable start address and pulse length
Level: TTL

Z Axis Output
Output to drive Z input of an oscilloscope during EDIT mode
Level: Progr. 0 to 9V (open circuit) typical
Impedance: 75Ω

Sync Trigger Out
Output to synchronize two or more ARB generators PM 5150
Level: TTL

Remote Interfaces

Serial RS-232 Interface
Baud Rate: 1200, 2400, 9600, 19200 baud
Parity: None, even, odd
Data Bits: 7 or 8
Stop Bits: 1 or 2
Handshake: Hardware or software

IEEE Interface
Norm: IEEE-488.2

Operating Conditions

Reference Temperature: 23°C ±3°C
Operating Temperature: 0°C to 50°C
Storage Temperature: -20°C to +60°C
EMI: Meets requirements of VDE 0871 Class B, CISPR 11, EN 55011
Safety: Meets requirements of IEC 348 Class 1
Power Requirements: 100/120/220/240V
Line Frequency: 48 Hz to 63 Hz
Power Consumption: 50 VA
Warm-Up Time: 20 minutes
Size: 315 mm W x 105 mm H x 405 mm D (12.4 in W x 4.13 in H x 15.9 in D)
Weight: 6.7 kg (15 lb)

Ordering Information

Models

PM 5150/05n ARB Generator with 32K Memory, GPIB/IEEE-488 and RS-232 Interface
PM 5150/55n ARB Generator with 32K Memory, GPIB/IEEE-488 and RS-232 Interface, Sequencer

The n' indicates the required line cord. To select your line cord substitute the n' by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

Included with Instrument
Operating manual, power cord and fuse.

Accessories (Also see Section 19)
PM 9515 Mouse
PM 9564 19" Rack Mount Adapter
PM 2295/10 IEEE-488 Bus Cable, 1 m
PM 2295/20 IEEE-488 Bus Cable, 2 m
PM 9536/501 RS-232 Cable, 3m, 9 pin/9 pin fem., with special adapter

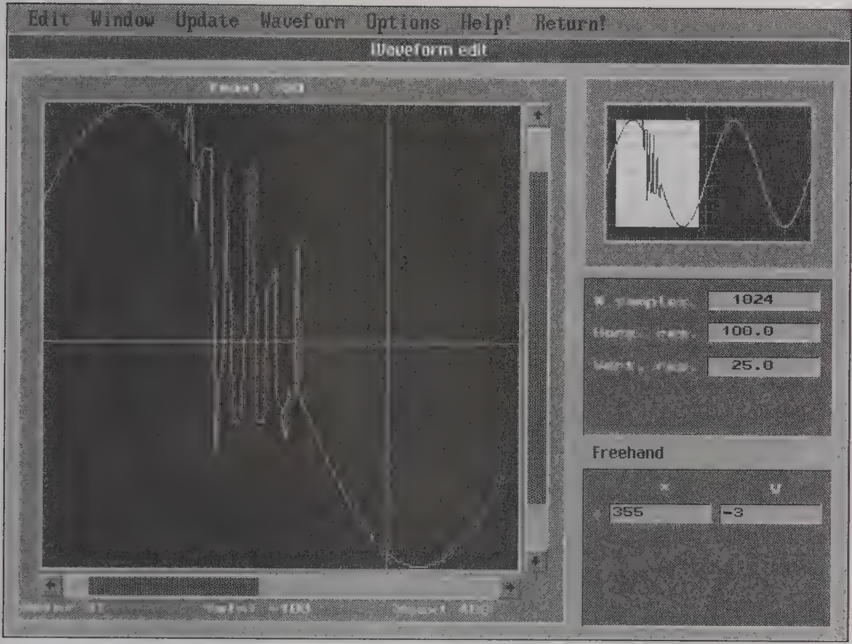
Manual
PM 5150 Operator*
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty (three-year product warranty in North America).

AnyWave™ Software



samples 1024
Horz. res. 100.0
Vert. res. 25.0

Freehand

x 355
y -3

AnyWave™ Software

- Intuitive user-interface; mouse-driven and easy to use
- Acquire and edit waveforms from a Fluke DSO; download to the PM 5150, PM 5138 or PM 5139 Arbitrary Waveform Generator
- Simultaneous display of zoomed and complete waveforms
- Sketch waveforms freehand or point-to-point
- Save and retrieve waveforms from your hard disk
- Create Envelopes for Pass/Fail Testing in your Fluke DSO

AnyWave™ Software turns your PC into an advanced tool for creating and editing arbitrary waveforms. Use your mouse to easily create any waveform you want to generate. With the full PC screen, advanced zooming features at your disposal, you can create your waveforms with all the detail you need. Recall one or more waveforms from a file and edit them as easily as a word processor document.

Quickly Create Complex Waveforms

For designing your waveform, AnyWave software gives you the choice of freehand draw and line draw mode. In line draw mode, build your waveform with line segments, point to point. In freehand mode, you can sketch your waveform directly, using the mouse as your "pencil". Zoom in on any particular portion of the waveform to get the details right while viewing the overall waveform in the secondary display. The mouse position is always displayed on the screen in voltage and time units, together with all properties of the waveform.

With AnyWave software, you can build individual waveform segments and join them together later. Or add a waveform captured from your Fluke DSO. Waveform parts can be copied from one waveform and inserted or appended in another waveform.

Build Complex Sequences with the PM 5150

AnyWave Software helps you program complex sequences in your PM 5150 with the sequence option installed. For example, a tone signal consisting of 1,000 good sine waves following by a noise burst can be done quickly and easily. To generate a sequence, create a series of steps which specify the waveform number and the number of times the waveform is to be repeated. The PM 5150 with optional sequencer can generate long, complex sequences that leave conventional arbitrary generators short of memory.

Capture Waveforms from your Fluke DSO

Uploading a waveform from your Fluke DSO to your PC can be done with a few keystrokes. Capture that elusive glitch signal with your scope. Now, pull it into AnyWave environment where you can archive it or modify it as needed. Next, download the glitch signal to your arbitrary waveform generator, where you can reproduce the signal at will, with the amplitude and speed you need. AnyWave software gets you in control of your waveforms.

Import Waveform Files from Other Sources

Waveform data stored as an ASCII text file from your favorite word processor or spread sheet program can be imported into your AnyWave environment. This import option also makes it possible to import waveforms from your other instruments which can store their waveforms as ASCII files.

Create Waveform Templates for Pass/Fail Testing

The Anywave waveform editor functions as a tool to create pass/fail templates for your Fluke CombiScope instrument. You can create your own reference templates consisting of upper and lower limits which you can save and retrieve from your hard disk and down load any time to your scope for pass/fail tests.

Supported Instruments

4-Channel CombiScope™ Instruments: PM 3382, PM 3384, PM 3392, PM 3394 with GPIB or serial interface
2-Channel CombiScope Instruments: PM 3335, PM 3350A, PM 3355, PM 3365A, PM 3375 with GPIB interface
ScopeMeter®: PM 97 with serial interface
Arbitrary/Function Generators: PM 5138, PM 5139 with GPIB interface
Arbitrary Waveform Generator: PM 5150 with GPIB or serial interface

System Requirements

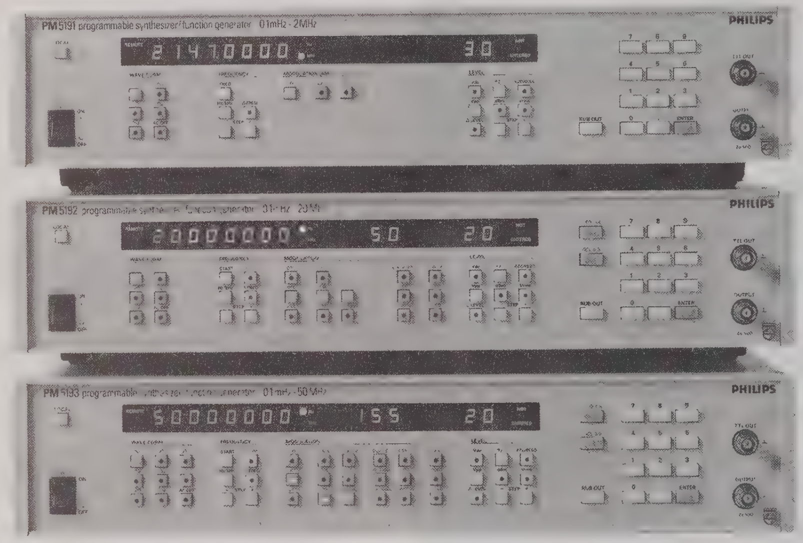
IBM PC/AT, PS/2 or compatible
Floppy disk and one hard disk drive
Minimum of 550KB of free internal memory
Microsoft Mouse or compatible
Optional PM 2201, PM 2202 or National Instruments GPIB interface card

Ordering Information

Models

PM 2273/001	AnyWave Software
PM 2273/901	AnyWave Software Multicopy Version

PM 5191, PM 5192 & PM 5193



PM 5191/92/93

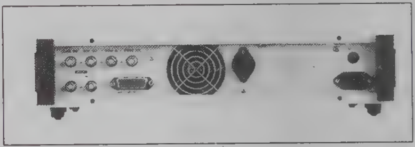
PM 5191, PM 5192 & PM 5193 Synthesized Function Generators
Wide frequency ranges: 0.1 mHz to 2.147, 20 or 50 MHz
8 standard waveforms (PM 5193) or 5 waveforms (PM 5192/91)
8 Digit Frequency Resolution
Maximum 20V p-p output (PM 5191: 30V p-p) plus TTL ouput
Independent amplitude and offset
GPIB/IEEE-488 interface standard
Modulation facilities including AM (all models) FM, Gate and Sweep (PM 5192 and PM 5193), plus Burst (PM 5193)
Video modulation facilities with model PM 5193V
10 MHz external synchronization with models PM 5191S, PM 5192S, PM 5193S

If you need precision, versatility and value in a waveform generator, Fluke offers a complete line of instruments that cover your requirements – exactly. Choose from the top-of-the-line PM 5193, with its 50 MHz frequency range. The versatile 20 MHz PM 5192. And the economical PM 5191, with excellent performance up to 2.147 MHz.

Each model offers you a comprehensive choice of waveform functions - up to eight on the PM 5193. AM, FM, gating and burst modes extend flexibility, and all can be modulated either internally by the generator, or by an external source. Linear and logarithmic sweep with fully independent start and stop frequencies and sweep times can also be made – with three different sweep modes (sweep and flyback, sweep and hold, sweep up and down). Add to this flexibility the precision of 8-digit resolution and high long-term stability, ensuring total reproducibility of your test routines.

PM 5193: The Most Versatile 50 MHz Performance

The PM 5193 offers complete versatility of performance, and a wide array of features to meet both today's and tomorrow's requirement. Complete in frequency range, with an exceptional $11\frac{1}{2}$-decade coverage and setting accuracy of better than 0.1 mHz. Complete in function selection, with a choice of eight waveforms that includes sine, square, ramps and haversine, plus a built-in pulse generator for positive and negative pulses with 3 ns transition times. Complete in modulation, with AM, FM, gating and counted burst with programmable single-shot or continuous operation, and programmable internal (to 200 kHz), or external modulation. Complete in sweep facilities, with linear and logarithmic sweep and three sweep modes, which can be controlled internally (single or continuous) or by an external trigger. Finally, complete for both bench top or systems applications, with ten stored set-up and full GPIB/IEEE-488* programmability.



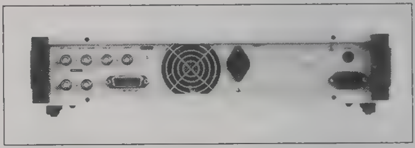
If you're budgeting for a 'standard' synthesizer/function generator, the PM 5193 offers you complete performance for about the same price. Compare and see how the PM 5193 can address your needs today for applications such as digital communications, calibration and use with state-of-the-art electronic equipment – plus the versatility to meet tomorrow's applications as well.

PM 5192: The New Standard in 20 MHz Synthesizer/Function Generators

If your applications require performance up to 20 MHz, the PM 5192 offers the features at a price you may not expect. With a frequency range from 0.1 mHz to 20 MHz, 8-digit precision and 1 ppm long-term stability, the PM 5192 provides the signals you need to guarantee the repeatability of your tests. Versatile enhanced by three modulation modes: AM, FM and gating. Both internal modulation (1 kHz) and external modulation (dc to 200 kHz) are possible in AM, FM and gating modes. Linear and logarithmic sweep with three different sweep modes-sweep and flyback, sweep and hold, sweep up and down – allow all standard waveforms to be used as carriers over the frequency range 1 mHz to 20 MHz. Sweep time is programmable from 10 ms to 999s.

The PM 5192 is equally at home on the bench, with ten stored set-ups, or in systems with its full IEEE-488 programmability.

The wide frequency range makes this model ideal for a wide range of applications in fields like mechanical and electrical engineering and electronics.



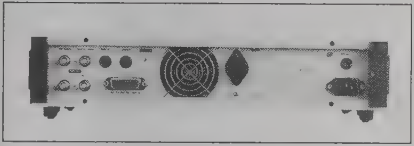
The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

PM 5191: The Value Leader

The PM 5191 brings 8-digit precision and repeatability and full IEEE-488 programmability to the budget-conscious engineers. A full 10-decade frequency range (From 0.1 mHz to 2.147 MHz), five standard waveforms and internal or external AM make this a versatile general-purpose instrument. Internal modulation (1 kHz) uses any of the waveforms as carrier, while external AM modulation covers a 200 kHz range. The carrier frequency is variable over the instrument's entire frequency range from 0.1 mHz up to 2.147 MHz.

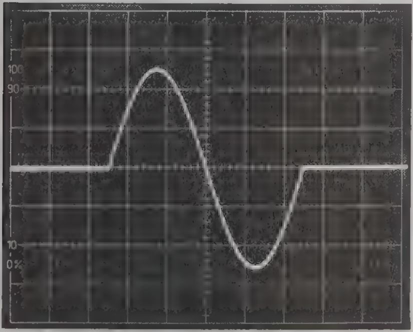
The PM 5191 also offers phase noise of –80 dBc/Hz and a high 30V pp output level.

With this outstanding combination of performance and value, the PM 5191 is well suited for lab or production line use, as well as for education and training.

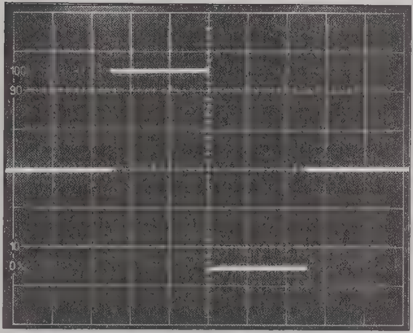


Wide Choice of Standard Waveforms

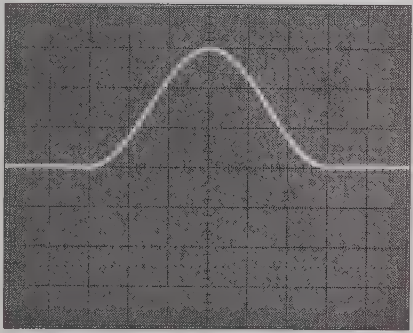
Each instrument offers a wide choice of standard waveform functions: no less than eight for the PM 5193, and five for the PM 5191 and PM 5192. All these functions are selectable either through the front panel or the IEEE-488 interface, with LED indicators to show at a glance which function is selected. Out-of-range or other invalid settings are indicated by blinking LED indicators, simplifying use of the front panel and the bus interface.



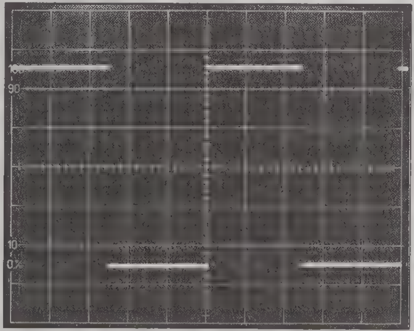
Sine wave



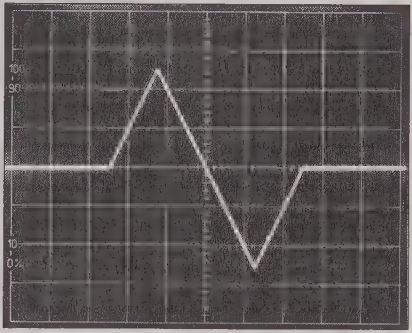
Square wave



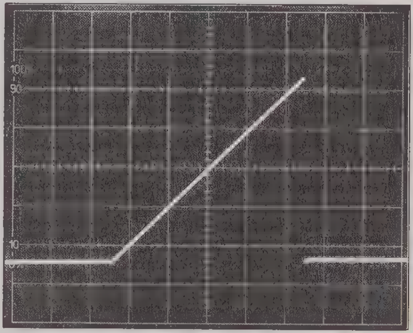
Haversine (sine² signal) (PM 5193 only)



Positive and negative pulses with 3 ns transition time (PM 5193 only)



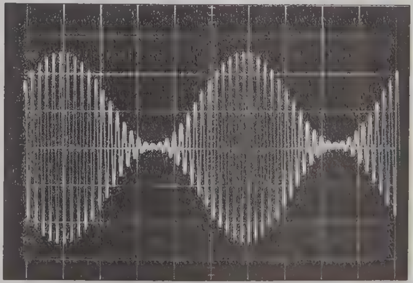
Triangle



Positive and negative ramps

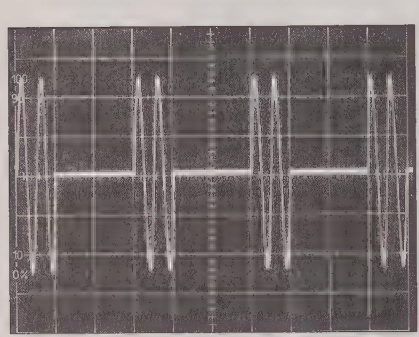
Instantly Selectable Modulation Modes

All required modulation modes are also instantly available at the touch of a button covering AM, FM, burst and gating. For sweep you have a choice of linear or logarithmic sweep and a selection of sweep modes: sweep and re-trace, sweep up - sweep down, or sweep-and-hold.

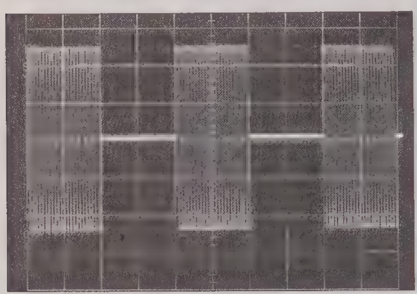


Carrier wave with amplitude modulation; 100% modulation depth

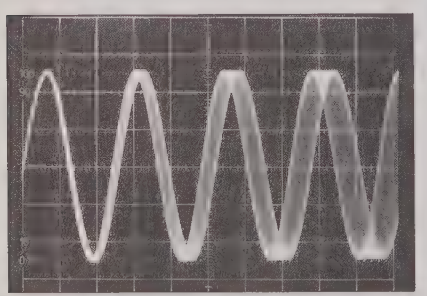
PM 5191, PM 5192 & PM 5193



Burst signal, programmable on/off cycles; 2 on, 4 off cycles (PM 5193 only)



Gated signal; non-phase-coherent on/off keying (PM 5192/PM 5193 only)



Oscillogram showing frequency sweep or frequency modulation (PM 5192/PM 5193 only)

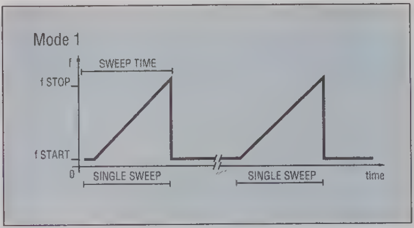


Figure 1.

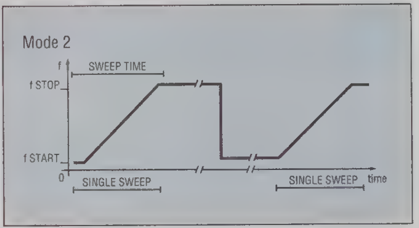


Figure 2.

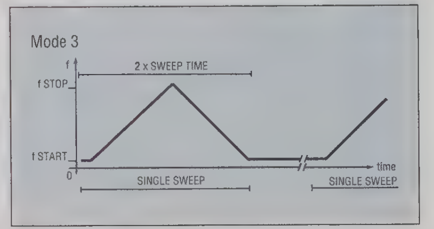


Figure 3.

Precise Frequency Programming

The frequency keypad area allows precise programming of all frequency-related settings, choice of scale (Hz/kHz) and frequency steps. These preset frequency steps can then be repeated manually using the step + or - buttons.

Versatile Output Level Setting

The desired output levels in V pp, V rms or dBm can be selected by a special keypad, while the selected output voltage is indicated on the LED display. A step function allows quick changes in output level in presettable steps.

Specially developed circuitry prevents any interaction between ac and dc settings. The signal outputs, including a TTL output, are short-circuit proof.

Full GPIB/IEEE-488 Program-mability Adds Extra Versatility

The full IEEE-488 programmability of all these Philips synthesizer/function generators adds an important extra dimension to their versatility.

Built-in Learn and Identification modes speed and simplify IEEE-programming. In Learn mode, complete strings of instruction representing front-panel settings can be transmitted to the controller. The same instrument set-up can be reproduced whenever required, simply by re-transmitting the same string of instructions. In the Identification mode, the instrument automatically responds to an identification request from the controller by transmitting its type number and software version.

10 MHz External Synchronization

In many applications where frequency synthesizers are used, the possibility of synchronizing the outputs of two or more synthesizers is valuable when it is desired to have signals of exactly the same frequency, precisely determined frequency rations or in locked phase conditions.

The Philips PM 5191, PM 5192 and PM 5193 synthesizers all use the same synchronization frequency of 8.6 MHz, allowing convenient synchronization of any combination of these instruments.

For applications demanding traceability to an external standard, the PM 5191S, PM 5192S and PM 5193S generators can be synchronized with external standards at 10 MHz, or sub-harmonics such as 1, 2 or 5 MHz.

Note: Phase locking to other 10 MHz instruments using the external reference is not possible.

Quick Selection Table

	PM 5191	PM 5192	PM 5193
Maximum Frequency	2 MHz	20 MHz	50 MHZ
Waveforms	5	5	8
Output Voltage Vp-p	30	20	20
Internal Modulation	1 kHz	1 kHz	10 Hz - 200 kHz
INT/EXT AM	y	y	y
INT/EXT FM	–	y	y
INT/EXT SATE	–	y	y
Sweep	–	y	y
Burst	–	–	y
Front Panel Setups	1	10	10

Video Modulation Facilities

The PM 5193V adds video modulation facilities to the wide range of waveforms and modulation facilities of the standard instrument. In this version, video modulation is provided by an external modulation signal, and replaces the AM external modulation mode of the PM 5193.

PM 5193 Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 0.1 mHz to 50 MHz
Operational Range: Sine wave 50 MHz
Positive pulse 50 MHz
Negative pulse 50 MHz
Square wave 20 MHz;
Triangle 200 kHz;
Haversine 50 kHz
Positive sawtooth 20 kHz;
Negative sawtooth 20 kHz
Setting: Local via front-panel keyboard. Remote via IEEE-488 bus interface ± stepping function with programmable step width.
Resolution: 8 digits; >0.1 mHz
Display: 8-digit LED display, Hz/kHz indication
Setting Error: $<1 \times 10^{-6}$
Frequency Jitter: 0.02%, <1200 Hz; f ≥2 MHz, LF bandwidth 10 Hz to 20 kHz
Temperature Coefficient: <0.2 ppm/K
Aging: <1 ppm per year
Drift: <0.3 ppm in 7 hours

Output Characteristics

Connector: BNC socket on front or rear panel
Impedance: $Z_0 = 50\Omega$
Load Capability: Short-circuit proof
Maximum External Voltage: ±12V p-p (<3 min.)

AC Voltage

Independent of dc settings within ±10V window
Ranges: Range I 2.1 to 20V p-p open-circuit voltage; Range II 0.21 to 2.00V p-p open-circuit voltage; Range III 0 to .200V p-p open-circuit voltage
Resolution: Range 1 0.1V; Range II 0.01V; Range III 0.001V
Setting: Remote or local +/- stepping
Programmable step width
Alternative Settings: V rms, dBm
Basic Setting Error: ±2% (1 Hz to 200 kHz) V p-p >2.1V

DC Voltage

Independent of ac setting within ±10V window
Range: ±10V open-circuit voltage
Resolution: 0.1V
Error: ±2% of setting
Offset: <0.03V (Vac ≤2V); <0.08V (Vac >2V)
Setting: Remote or local; +/- stepping function. Programmable step width.

TTL Output

Connector: BNC socket on front panel
Fan-Out: 5 TTL inputs
Level: 0/>3.5V

Waveforms

Standard Functions: Sine wave, square wave, triangle, haversine, sawtooth (positive- and negative-going ramps), positive and negative pulse
Selection: Local via front panel keyboard. Remote via GPIB/IEEE-488 bus interface.
Indication: Key LEDs

Sine Wave

Frequency Range: 0.1 mHz to 50 MHz
Output Range: 0 to 20V p-p

Distortion

THD: typ. 92%, <0.5% (f = 1 Hz to 200 kHz)
typ. 0.4%, <0.7%, (f = 200 kHz to 2 MHz)
Harmonics:<-37 dBc (f<10 MHz, Vp-p >10 mV)
Spurious: <-40 dBc (2 MHz< f <50 MHz, open circuit voltage ≥100 mV p-p, distance from carrier >15 kHz); <-50 dBc (0.1 mHz< f <2 MHz, open circuit voltage ≥100 mV p-p)

Haversine

Frequency Range: 0.1 mHz to 50 kHz
Output Range: 0 to 10V p-p
Distortion: <0.8% (output >10 mV p-p)

Square Wave

Frequency Range: 0.1 mHz to 20 MHz
Transition Times: 10 ns typically, <11.5 ns
Duty Cycle: 50%
Aberration: <2% ±20 mV range I; <2% ±3 mV range II

Triangle

Frequency Range: 0.1 mHz to 200 kHz
Output Range: 0 to 20V p-p
Temperature Coefficient: <0.1%/K
Linearity: >99%

Sawtooth (pos/neg ramps)

Frequency Range: 0.1 mHz to 20 kHz
Output Range: 0 to 10V p-p
Temperature Coefficient: <0.1%/K
Flyback Time: <1 µs
Linearity: <99%

Pulse

Frequency Range: 0.1 mHz to 50 MHz
Output Range: 1.0 to 10V p-p
Rise/Fall Time: 3 ns typical, <4.5 ns
Aberration: <2% ±40 mV

Modulation

Modes: AM int /ext, FM int/ext, lin/log sweep, gate int/ext, burst. Internal modulation frequency programmable via keypad.
Resolution: Range I (0.01 to 0.99 kHz): 10 Hz
Range II (1.0 to 9.9 kHz): 0.1 kHz
Range III (10 to 200 kHz): 1.0 kHz

Internal AM

Carrier Frequency: 0.1 mHz to 50 MHz
Carrier Wave: All, except pulses
Modulation Frequency: 10 Hz to 200 kHz
Modulation Depth: 0 to 100%
Resolution: 1%
AM Envelope Distortion: <2% (m ≤98%); <1.5% (m <50%, fm 100 Hz to 20 kHz)

External AM

Modulation Frequency: 0 to 200 kHz
AM Envelope Distortion: 2% (m <98%); 1.5% (m<50%; fm 100 Hz to 20 kHz)

Internal FM

Carrier Frequency: >2 MHz
Modulation Frequency: 10 Hz to 200 kHz
Deviation: 10 kHz to 200 kHz
Resolution: 1 kHz
Modulation Distortion: <1% (f ≤30 MHz; Df ≤100 kHz; fm ≥200 Hz to ≤50 kHz)

External FM

Carrier Frequency: >2 MHz
Modulation Frequency: 10 Hz to 200 kHz
Deviation: 10 kHz to 200 kHz
Distortion: <1%

Sweep

Carrier Wave: All waveforms
Sweep Functions: lin/log, up/down, single/continuous, hold/release
Range: 1 mHz to 50 MHz phase-continuous, depending on waveform; independent setting of start and stop frequencies
Sweep Time: 10 ms to 999s
Resolution: Maximum 0.01s (3 digits)
Error: 0.1 ms, sweeptime ≤4s

Internal Gate

Non phase-coherent signal keying
Carrier Frequency: 0.1 mHz to 50 MHz (depending on waveform): carrier wave: all except pulses
Modulation Frequency: 10 Hz to 200 kHz
Duty Cycle: 50%

External Gate

Modulation Frequency: 0 to 500 kHz; min on/off time 2 µs

Burst

Carrier Frequency: <2 MHz all carrier waveforms
On and Off Cycles: 1 to 200 programmable
Burst Functions: Single/continuous
External Triggering: TTL positive edge; via modulation input
Maximum Repetition Rate: 1 kHz

Video Modulation (PM 5193V only)

Carrier Waveform: Sine
Carrier Frequency: ≤50 MHz
Modulation Bandwidth (-1 dB): ≥8 MHz; carrier frequency <45 MHz
External Modulation Signal: CVBS; amplitude: 1V p-p
Maximum DC Offset: ±5V
Modulation Mode: Double sideband amplitude modulation (A3F), negative poarity
RF Synchronizing Level: 100%
Residual Level (white level): 11 ±3%; related to RF synchronising level

PM 5191, PM 5192 & PM 5193

Independent Linearity Error: ≤2% between black and white level
Connector: BNC; "VIDEO IN" at rear of the instrument
Impedance: 75Ω

GPIB/IEEE-488 Bus Remote Control

Control Capability: All signal functions and characteristics
Interface Functions: AH1, L4, RL1, SR1, SH1, T6
Listener Address: Programmable via keyboard, indicated by LED display
Address Range: 0 to 30
Service Request: Error and single end message
Remote Lock-Out: Go-to local front panel key. Device identification and learn modes provided as standard.

10 MHz Output (PM 5193S only)

Protection: Short-circuit proof, maximum external voltage 10V
Frequency: 10 MHz (squarewave)
Level: Typical 2 dBm >0 dBm
Impedance: 50Ω

External Reference Input (PM 5193S only)

Maximum Voltage: ±5V
Waveform: Sine or square
Frequency: $\frac{10\text{ MHz}}{N}$ N = 1,2,3 to 10 for Synchronization purposes <2s
Lock-In Range: ±0.1% – a relative frequency offset of the reference frequency, results in the same relative offset of the output frequency
Level: 0 to 20 dBm
Impedance: 50Ω

Note: It is not possible to phase lock with other 10 MHz instruments

General Specifications

Miscellaneous

Non-Volatile Memory: 1 memory location for last setting. 9 memory locations for programmable settings.
Rear Connectors: Modulation output BNC; Sweep output BNC; Pen-lift output BNC; Clock output BNC; Modulation Input BNC; Clock input BNC; GPIB/IEEE-488 bus connector; Mains connector

Operating Conditions

Reference Temperature: +23°C ±1°C
Operating Temperature: +5°C to +40°C
Storage Temperature: -20°C to +70°C

Power Requirements

Line Voltage: 100V, 120V, 220V, 240V, tolerance ±10%
Line Frequency: 50 Hz to 60 Hz, tolerance ±5%
Power Consumption: 105W

Mechanical Specifications

Size: 105 mm H x 440 mm W x 430 mm L (4.1 in H x 17.3 in W x 15.6 in L), rack mounting facility standard (2 units high)
Weight: 10.5 kg (23 lb)

Ordering Information

Models

U.S. Versions

PM 5193M Programmable Synthesizer/Function Generator
PM 5193SM Programmable Synthesizer/Function Generator with 10 MHz Reference Input
PM 5193VM Programmable Synthesizer/Function Generator with Video Modulation

European Versions

PM 5193 Programmable Synthesizer/Function Generator
PM 5193S Programmable Synthesizer/Function Generator with 10 MHz Reference Input
PM 5193V Programmable Synthesizer/Function Generator with Video Modulation

Included with Instrument

One-year product warranty, line cord, rack mounting brackets, programming card, Operator's manual and Certificate of Calibration Practices.

Option

Rear Panel Output

Accessories (Also see Section 19)
PM 9051 BNC to 4 mm Banana Adapter
PM 9551 50Ω to 600Ω Adapter
PM 9581/01 50Ω Feedthrough Termination 3W
PM 9585/01 50Ω Feedthrough Termination 1W
PM 9613/01 Rack Slide Kit
PM 2255 Instrument Drivers Software
PM 2250/001* TestTeam Plus Software

**Available in European countries only*

Manuals

PM 5193 Operator*
PM 5193 Programming Card*
PM 5193 Service

**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty

One-year product warranty.

PM 5192 Specifications

Technical Specifications

Frequency Characteristics

Nominal Range: 0.1 mHz to 20 MHz
Operational Range:
Sine wave 20 MHz;
Square wave 20 MHz;
Triangle 200 kHz;
Positive sawtooth 20 kHz;
Negative sawtooth 20 kHz
Setting: Local via front-panel keyboard. Remote via GPIB/IEEE-488 bus interface +/- stepping function with programmable step width.
Resolution: 8 digits; >0.1 mHz
Display: 8-digit LED display, Hz/kHz indication
Setting Error: $<1 \times 10^{-6}$
Frequency Jitter: <0.01%, <500 Hz, f≥2 MHz, LF bandwidth 10 Hz to 20 kHz
Temperature Coefficient: <0.2 ppm/K
Aging: <1 ppm per year
Drift: <0.3 ppm in 7 hours
Synchronization: 2 (or more) PM 5192 generators can be synchronized by rear socket connection

Output Characteristics

Main Output
Connector: BNC socket on front or rear panel
Impedance: $Z_0 = 50\Omega$
Load Capability: Short circuit proof
Maximum External Voltage: ±12V p-p (<3 min)

AC Voltage

Independent of DC settings within ±10V window
Ranges: I 2.1 to 20V p-p open-circuit voltage;
II 0.21 to 2.00V open-circuit voltage;
III 0 to 0.200V open-circuit voltage
Resolutions: Range I 0.1V;
Range II 0.01V;
Range III 0.001V
DC Voltage
Independent of AC setting within ±10V window
Range: +/- 10V open-circuit voltage
Resolution: 0.1V
Error: ±2% of setting
Offset: <0.03V (Vac ≤2V); <0.08V (Vac >2V)
Setting: Remote or local; +/- stepping function. Programmable step width.

TTL Output

Connector: BNC socket on front panel
Fan-Out: 5 TTL inputs
Level: 0/>3.5V

Waveforms

Standard functions: Sine wave, square wave, triangle, sawtooth (positive- and negative-going ramps)
Selection: Local via front panel keyboard. Remote via GPIB/IEEE-488 bus interface.
Indication: Key LEDs

Sine Wave

Frequency Range: 0.1 mHz to 20 MHz
Output Range: 0 to 20V p-p

Distortion

THD: typical 92%, <0.5% (f = 1 Hz to 200 kHz)
typical 0.4%, <0.7% (f = 200 kHz to 2 MHz)
Harmonics: <-37 dBc (f<10 MHz, Vp-<10 mV)
Spurious: <-40 dBc (2 MHz<f <20 MHz, open circuit voltage ≥ 100 mVp-p, distance from carrier >15 kHz); <-50 dBc (0.1 mHz < f <2 MHz, open circuit voltage ≥100 mVp-p, distance from carrier >15 kHz)

Square Wave

Frequency Range: 0.1 mHz to 20 MHz
Transition Times: 10 ns typical, <11.5 ns
Duty Cycle: 50%
Aberration: <2% ±20 mV range I; <2% ± 3 mV range II

Triangle

Frequency Range: 0.1 mHz to 200 kHz
Output Range: 0 to 20V p-p
Temperature Coefficient: <0.1%/K
Linearity: >99%

Sawtooth (pos/neg. ramps)
Frequency Range: 0.1 mHz to 20 kHz
Output Range: 0 to 10V p-p
Temperature Coefficient: <0.1%/K
Flyback Time: <1 µs
Linearity: >99%

Modulation

Modes: AM int/ext, FM int/ext, lin/log sweep, gate int/ext internal modulation frequency 1 kHz

Internal AM

Carrier Frequency: 0.1 mHz to 20 MHz
Modulation Frequency: 1 kHz
Modulation Depth: 0 to 100%
Resolution: 1%
AM Envelope Distortion: 1.5% (m <98%); 0.7% (m <50%)
Impedance of Modulation Source: ≤50Ω

Internal FM

Carrier Frequency: >2 MHz
Modulation Frequency: 1 kHz
Deviation: 10 kHz to 200 kHz
Resolution: 1 kHz
Modulation Distortion: <1% Df ≤100 kHz

External FM

Carrier Frequency: >2 MHz
Modulation Frequency: 10 Hz to 200 kHz
Deviation: 10 kHz to 200 kHz
Distortion: 1% impedance of modulation source: ≤50Ω

Sweep

Carrier Wave: All waveforms
Sweep Functions: lin/log, up/down, single/continuous, hold/release, triggered
Range: 1 mHz to 20 MHz phase-continuous, depending on waveform; independent setting of start and stop frequencies
Sweep Time: 10 ms to 999s
Resolution: Maximum 0.01s
Error: 0.1 ms, sweep time <4s

Internal Gate

Non-phase-coherent signal keying
Carrier Frequency: 0.1 mHz to 20 MHz (depending on waveform)
Modulation Frequency: 1 kHz
Duty Cycle: 50%

External Gate

Modulation Frequency: 0 to 500 kHz; minimum on/off time 2 µs

10 MHz Output (PM 5192S only)

Protection: Short-circuit proof, max. external voltage 10V
Frequency: 10 MHz (square wave)
Level: Typical 2 dBm >0 dBM
Impedance: 500Ω

External Reference Input (PM 5192S only)

Maximum Voltage: ±5V
Waveform: Sine or square
Frequency: $\frac{10\ \text{MHz}}{N}$ N = 1,2,3 to 10 for synchronization purposes

GPIB/IEEE-488 Bus Remote Control

Control Capability: All signal functions and characteristics
Interface Functions: AH1, L4, RL1, SR1, SH1, T6
Listener Address: Decimal programmable via keyboard, indicated by LED display
Address Range: 0 to 30
Service Request: Error and single sweep end message
Remote Lock-Out: Go-to local front panel key. Device Identification and learn modes provided as standard.

General Specifications

Miscellaneous

Non-Volatile Memory: 1 memory location for current setting, 9 memory locations for programmable setting
Rear Connectors: Modulation output BNC; **Sweep output BNC:** Pen-lift output BNC; Clock output BNC; Clock input BNC; IEEE-488 bus connector; Line connector

Operating Conditions

Reference Temperature: +23°C ± 1°C
Operating Temperature: +5°C to +40°C
Storage Temperature: -20°C to +70°C

Power Requirements

Line Voltage: 100V, 120V, 220V, 240V, tolerance ±10%
Line Frequency: 50 Hz to 60 Hz, tolerance ±5%
Power Consumption: 100W

Mechanical Specifications

Size: 105 mm H x 440 mm W x 430 mm L (4.1 in H x 17.3 in W x 16.9 in L), rack mounting facility standard (2 units high)
Weight: 10.5 kg (23 lb)

Ordering Information

Models

U.S. Versions
PM 5192M Programmable Synthesizer/Function Generator
PM 5192SM Programmable Synthesizer/Function Generator with 10 MHz Reference Input
European Versions
PM 5192 Programmable Synthesizer/Function Generator
PM 5192S Programmable Synthesizer/Function Generator with 10 MHz Reference Input

Included with Instrument
One-year product warranty, line cord, rack mounting brackets, programming card, Operator's manual and Certificate of Calibration Practices.

Option
Rear Panel Output

Accessories (Also see Section 19)
PM 9051 BNC to Banana Adapter
PM 9551 50Ω to 600Ω Adapter
PM 9581/01 50Ω Termination 3W
PM 9585/01 50Ω Termination 1W
PM 9613/01 Rack Slide Kit
PM 2250/001* TestTeam Plus Software
**Available in European countries only*

Manuals
PM 5192 Operating*
PM 5192 Programming Card*
PM 5192 Service
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.
Factory Warranty
One-year product warranty.

PM 5191 Specifications

Technical Specifications

Frequency Characteristics

Nominal Range: 0.1 mHz to 2.147 MHz
Operational Range: Sine wave 2.147 MHz;
Square wave 2.147 MHz;
Triangle 200 kHz;
Positive sawtooth 20 kHz;
Negative sawtooth 20 kHz
Setting: Local via front-panel keyboard. Remote via IEEE bus interface +/- stepping function with programmable step width

PM 5191, PM 5192 & PM 5193

Resolution: 8 digits; <0.1 mHz
Display: 8-digit LED display, Hz/kHz indication
Setting Error: $<1 \times 10^{-6}$
Temperature Coefficient: <0.2 ppm/K
Aging: <1 ppm per year
Drift: <0.3 ppm in 7 hours
Phase Jitter RMS: <3 mrad
Phase Noise: <-80 dBc/Hz (1 kHz from carrier)

Output Characteristics

Main Output
Connector: BNC socket on front or rear panel
Impedance: $Z_0 = 50\Omega$
Load Capability: Short-circuit proof
Maximum External Voltage: ±15V p-p (<3 min)

AC Voltage
Independent of dc settings within ±15V window
Ranges: I 3.1 to 30V p-p;
II 0.31 to 3.00V;
III 0 to 0.300V
Resolutions Ranges: Range I 0.1V;
Range II 0.01V;
Range III 0.001V
Setting: Remote or local +/- stepping. Programmable step width.
Basic Setting Error: ±2.5% (1 Hz to 200 kHz) (0.31V to 3.00V)

DC Voltage
Independent of ac setting within ±15V window
Range: +/- 10V open circuit voltage
Resolution: 0.1V
Error: ±2% of setting ±40 mV
Setting: Remote or local; +/- stepping function. Programmable step width.

TTL Output
Connector: BNC socket on front panel
Fan-Out: 5 TTL inputs
Level: 0/5V

Waveforms

Standard Functions: Sine wave, square wave, triangle, sawtooth (positive- and negative-going ramps)
Selection: Local via front panel keyboard. Remote via IEEE bus interface.
Indication: Key LEDs

Sine Wave
Frequency Range: 0.1 mHz to 2.147 MHz
Output Range: 0 to 30V p-p

Distortion
THD: <0.35% (1 Hz< f <200 kHz, open circuit voltage >10 mV p-p)
Harmonics: <-35 dBc (200 kHz< f, open circuit voltage ≥10 mV p-p)
Spurious: <-40 dBc (0.1 mHz< f, open circuit voltage >31 mV p-p, distance from carrier >15 kHz)

Square Wave
Frequency Range: 0.1 mHz to 2.147 MHz
Transition Times: <35 ns
Duty Cycle: 50%
Output Range: 0 to 30 p-p
Abberration: <2% ±20 mV range I; <2% ±3 mV range II

Triangle
Frequency Range: 0.1 mHz to 200 kHz
Output Range: 0 to 30V p-p
Temperature Coefficient: <0.1%/K
Linearity: >99%

Sawtooth (pos/neg ramps)
Frequency Range: 0.1 mHz to 20 kHz
Output Range: 0 to 15V p-p
Temperature Coefficient: <0.1%/K
Flyback Time: <1 µs
Linearity: >99%

Modulation

Internal AM
Carrier Frequency: 0.1 mHz to 2 MHz
Modulation Frequency: 1 kHz
Modulation Depth: (30 ±2)%
Modulation Distortion: <0.6% (sine wave modulation)
Modulation Output: 0.3V eff ±3%

External AM
Modulation Frequency: 0 to 200 kHz
Modulation Distortion: <1.5% (depth <98%) <0.7% (depth <50%)

10 MHz Output (PM 5191S only)
Protection: Short-circuit proof, maximum external voltage 10V
Frequency: 10 MHz (square wave)
Level: Typical 2 dBm >0 dBm
Impedance: 50Ω

External Reference Input (PM 5191S only)
Maximum Voltage: ±5V
Waveform: Sine or square
Frequency: $\frac{10\text{ MHz}}{N}$
Lock-In Time: <2s
Lock-In Range: ±0.1% – a relative frequency offset of the reference frequency, results in the same relative offset of the output frequency
Level: 0 to 20 dBm
Impedance: 50Ω

IEEE-488 Bus Remote Control

Control Capability: All signal functions and characteristics
Interface Functions: AH1, L4, RL1, SR1, SH1, T6
Listener Address: Decimal programmable via keyboard, indicated by LED display
Address Range: 0 to 30
Service Request: Error message
Remote Lock-Out: Go-to local front panel key. Device Identification and learn modes provided as standard.

General Specifications

Miscellaneous

Non-Volatile Memory: 1 memory location for current setting
Rear Connectors: Modulation output BNC; Clock output BNC; Modulation input BNC; Clock input BNC; IEEE bus connector; Mains connector

Operating Conditions

Reference Temperature: 23°C ±1°C
Operating Temperature: 5°C to 40°C
Storage Temperature: -20°C to +70°C

Power Requirements

Line Voltage: 100V, 120V, 220V, 240V, tolerance ±10%
Line Frequency: 50 Hz to 60 Hz, tolerance ±5%
Power Consumption: 100W

Mechanical Specifications

Size: 105 mm H x 440 mm W x 430 mm L (4.1 in H x 17.3 in W x 16.9 in L), rack mounting facility standard (2 units high)
Weight: 10 kg (22 lb)

Ordering Information

Models

U.S. Versions
PM 5191M Programmable Synthesizer/Function Generator
PM 5191SM Programmable Synthesizer/Function Generator with 10 MHz Reference Input

European Versions
PM 5191 Programmable Synthesizer/Function Generator
PM 5191S Programmable Synthesizer/Function Generator with 10 MHz Reference Input

Included with Instrument
One-year product warranty, line cord, rack mounting brackets, programming card, Operator's manual and Certificate of Calibration Practices.

Option
Rear Panel Output

Accessories (Also see Section 19)
PM 9051 BNC to 4 mm Banana Adapter
PM 9551 50Ω to 600Ω Adapter
PM 9581/01 50Ω Feedthrough Termination 3W
PM 9585/01 50Ω Feedthrough Termination 1W
PM 9613/01 Rack Slide Kit
PM 2255 Instrument Drivers Software
PM 2250/001* TestTeam Plus Software
**Available in European countries only*

Manuals
PM 5191 Operator*
PM 5191 Programming Card
PM 5191 Service
**No charge with purchase of unit*

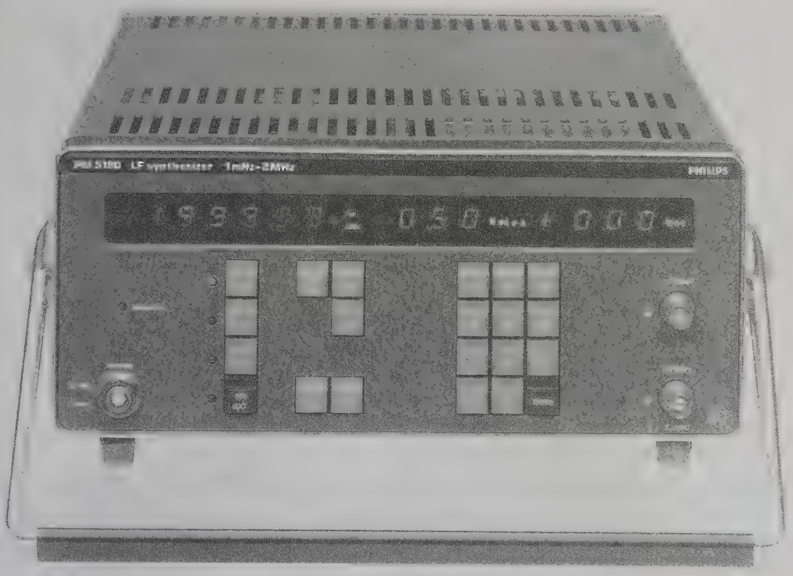
Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

PM 5190X

GPIB IEEE-488


PM 5190X

PM 5190X 2 MHz Synthesized Function Generator

- Sine, triangle, square waveforms
- 0.001 Hz to 2.147 MHz frequency range
- Max 20V p-p output and separate TTL output
- Excellent short- and long-term stability
- External amplitude modulation capability
- Direct digital synthesis for fast setting times
- Fast feather-touch parameter selection

This function generator, based on a direct digital synthesis technique, includes many unique features that lift it into a special class of medium-priced signal sources for many professional applications. Features include ±1 x 10^{-6} frequency setting error and an aging characteristic of <1.5 x 10^{-6}/year, clearly demonstrating the inherently high accuracy and stability of this instrument.

It will thus be of interest to design or research laboratories seeking such a highly accurate, stable signal source in the range 0.001 Hz to 2.147 MHz for both routine bench use and inclusion in automatic test systems. Its high-grade, virtually zero-error performance, plus simplicity and speed of operation make it equally attractive for use in advanced educational programs.

The user has a choice of sine, square and triangle waveform outputs, all available from a 50Ω front panel BNC connector.

In addition, there is an adjacent TTL socket. External amplitude modulation signals, from 0% to 90% modulation depth can be connected via a rear input socket.

Maximum ac output voltage for all waveforms is 19.9V p-p. A dc offset voltage of up to 9.9V max is available for setting the output to the desired dc level, up to 19.9V total amplitude. Voltage levels can be set in minimum increments of 1 mV.

A very clear, simply designed front panel makes operation extremely easy. Fast selection of the desired parameters is assured by 'feather-touch' input pushbuttons.

The output frequency of the crystal controlled oscillator is shown on a bright 6-digit LED display together with the ac (2 digits) and dc (2 digits) outputs. DC polarity is also displayed. In addition, the preselected waveforms and external amplitude modulation characteristics are indicated on this panel.

All functions are fully controllable via the built-in IEC-bus interface, or GPIB/IEEE-488* via PM 2296/60, supplied with the instrument. This enables the PM 5190X be used within an automatic testing system. This facility is further enhanced by the high switching speeds resulting from a direct digital signal synthesis technique.

All these comprehensive facilities are contained in a very compact, portable package.

Typical applications in an automated system include:

- Accurate testing of audio filters when checking bandpass curves.
- As a standard, when checking servo motor speed control systems or for audio/video tape stress testing, etc.

Also, when employed as a signal source for calibrating instruments (e.g. frequency meters) its highly accurate and stable output signal may be used.

Specifications

Technical Specifications

Frequency

Nominal Range: 1 mHz to 2.147 MHz
Measuring Range: 1 mHz to 2.147 MHz for sine and square wave; 1 mHz to <100 kHz for triangle wave

Setting

Local: Via front panel keyboard
Remote: Via IEC bus interface
Display: 6-digit 7-segment LED display; 6 decimal points; 2 LEDs for dimension Hz, kHz
Setting Error: ±1 x 10^{-6} at 23°C
Temperature Coefficient: <1 x 10^{-6}/C
Aging: <1.5 x 10^{-6} per year

Waveforms

Sine wave
Square wave
Triangle wave
All time-symmetrical
All with or without dc offset
DC voltage without ac

Selection

Local: Via front panel keyboard
Remote: Via IEC bus interface
Indication: LEDs for the selected waveforms

Sine Wave

Total Harmonic Distortion: <0.4% (1 mHz to 50 kHz); <1.5% (50 kHz to 2.147 MHz)
Non-Harmonic Components at Max Amplitude: ≤46 dB
Phase Noise: ≤50 dB within 30 kHz bands, centered to the output frequency; (frequencies <50 kHz)

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 5190X

Square Wave
Rise Time, Fall Time: <50 ns
Tilt: <3% (f <100 kHz)
Overshoot: <3%
Duty Cycle: 50%
Duty Cycle Tolerance: <0.5% (1 kHz)

Triangle Wave
Frequency Range: 1 mHz to 100 kHz
Linearity: <99% for frequencies <10 kHz

Modulation

Mode: Amplitude modulation, external
Indication: LED
Carrier: Sinusoidal and triangular waveform frequency >10 Hz
Modulation Frequency: DC to 20 kHz
Modulation Coefficient: 0.1V per 10% AM
Modulation Depth: 0% to 90%
Connector: BNC socket AM EXT (rear side)
Input Impedance: 20 kΩ
Max. External Voltage: ±30V
Reference Potential: External contact of BNC socket

Output Characteristics

Connector: BNC socket (front side)
Impedance: 50Ω ±2%
Short-Circuit Proof: Yes
Max. External Input Voltage: ±15V
Reference Potential: External contact of BNC socket

AC Voltage

Range: 19.9V ac p-p open circuit

Sub-Ranges
I .000V to 0.199V ac
II 0.00V to 1.99V ac
III 00.0V to 19.9V ac

Setting
Local: Via front panel keyboard
Remote: Via IEC bus interface
Resolution: 2$^1/_2$ digit
Setting Error: 3% for settings 2.0V to19.9V for frequencies <100 kHz
Temperature Coefficient: 0.1%/C

DC Offset Voltage

Range: 0 to 9.9V dc

Sub-Ranges
I .000V to 0.099V dc
II 0.00V to 0.99V dc
III 00.0V to 09.9V dc

Sub-Range Selection: Determined by sub-range setting

Mimimum Increments
1 mV in sub-range I
10 mV in sub-range II
100 mV in sub-range III

Polarity: Positive or negative selectable via keyboard

Setting
Local: Via front panel keyboard
Remote: Via IEC bus interface
Resolution: 2-digits
Display: Polarity ±2-digit, 7-segment LED, decimal point, position determined by ac decimal point setting
Setting Error: ±4% (10% to 100% of each subrange)
Temperature Coefficient: <0.1%/K (10% to 100% of each subrange)
Max. DC Voltage Setting: Depending on ac voltage setting: dc indication ≤100 - (ac indication)/2; decimal points ignored

TTL Output
Connector: BNC socket TTL OUT
Duty Cycle: 50%
Fan Out: ≥10
Level: Standard TTL-level

Remote Control

Interface: Built-in IEC 625 interface, compatible with IEEE-488 via separate adaptor PM 2296/60 IEC-625/GPIB/IEEE-488 adaptor supplied with the instrument
Remote State Indication: Front panel LED
Programmable Parameters: Frequency, ac voltage, dc voltage, waveform
Response Time: 4 ms for waveform, 10 ms for ac voltage, 7 ms for frequency, 12 ms for dc voltage

GPIB/IEEE-488/IEC Interface Data

An IEC-625 interface is supplied, built into the instrument, with rear access; compatible with IEEE-488 via included PM 2296/60 adaptor
Connector: 25-pole IEC standard connector

Interface Functions

AH1	Acceptor handshake
L2	No additional functions possible
RL2	Remote/local total capability

Code: ISO 7-bit code
Connector: 25-pole standard interface connector (rear side)

Max. External Voltage: -0.5 to +5.5V, standard TTL level
Reference Potential: Measuring earth
Connector Housing: Connected to protective conductor

General Specifications

Power Requirements

Voltage: 110V, 128V, 220V, 238V ±10%
Power Consumption: 47W
Frequency: 47.5 Hz to 63 Hz

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Range: +5°C to +40°C
Limits for Storage and Transportation: -40°C to +70°C

Mechanical Data

Size: 310 mm W x 140 mm H x 365 mm L (12.5 in W x 5.5 in H x 14.5 in L)
Weight: 6 kg (13.2 lb)

Ordering Information

Model

U.S. Version
PM 5190XM LF Synthesizer with ENTER key

European Version
PM 5190X LF Synthesizer with ENTER key

Included with Instrument
Instruction manual, attached line cord, and PM 2296/60 IEC-625/IEEE-488 interface adapter.

Accessories (Also see Section 19)
PM 9075 Coaxial Cable BNC BNC
PM 9560 19-in Rack Mount Adapter
PM 9551 50Ω to 600Ω Impedance Adapter
PM 2296/60 IEC-625/GPIB/IEEE-488 Adapter
Y8021 Shielded IEEE-488 Cable, 1m (3.28 ft)
Y8022 Shielded IEEE-488 Cable, 2m (6.56 ft)
Y8023 Shielded IEEE-488 Cable, 4m (13 ft)

Manual
PM 5190 Instruction*

**No charge with purchase of unit*

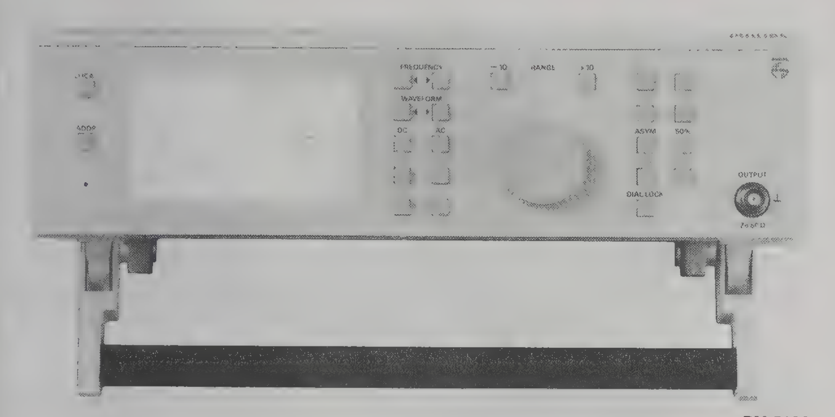
Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

PM 5138 & PM 5139

GPIB
IEEE-488



PM 5138

PM 5138/39 10 MHz/20 MHz Function Generators

- Large backlit LCD display and menu controlled operation
- Frequency range from 0.1 mHz to 20 MHz (PM 5139) or 10 MHz (PM 5138)
- 10 standard waveforms (PM 5139) or 7 standard waveforms (PM 5138)
- Arbitrary waveforms on instruments with GPIB/IEEE-488.2 interface
- Non-volatile memory stores up to 6 user-defined waveforms (PM 5139)
- Programmable internal trigger/modulation source 1 mHz to 100 KHz (PM 5139)
- Selectable Low Z_0 or 50Ω output impedance (PM 5139)
- Internal/external modulation modes include AM, FM, PSK, Sweep, BURST, and GATE

Fluke makes precision function generation easier than ever with the PM 5138 and PM 5139. These high-performance instruments bring a new concept to waveform generation and frequency synthesis: full menu-driven operation. Just a few push buttons let you select the function you want. While a single, large control knob allows precise setting of all numeric values.

Fast, Simple and Precise

With these precision instruments, setting-up your test signal is faster, simpler and more precise than ever before. At all times, you get a clear indication of the selected signal on the large backlit LCD display. With an instant, at-a-glance readout of vital parameters such as frequency, waveform, amplitude, offset and modulation. So you're always fully informed about instrument status, selections and other essential test parameters.

Step-Through Menu Lines

To change a setting, all that's necessary is to select one of the five menu lines and press the corresponding buttons. In each case, the 'active' parameter is clearly indicated on-screen by an arrow. Then, you can step through the available options, which are highlighted one-by-one on the display. These five menu lines let you make all instrument settings instantly and precisely.

All numeric values such as frequency, offset and modulation depth are set with high precision by the control knob.

Precision Performance

The PM 5138 and PM 5139 give you a degree of precision that you wouldn't expect from economically priced general purpose function generators.

Frequency accuracy – among the most important parameters for a function generator – is better than 2 ppm.

Special Function Selection

Specific function keys are conveniently located in a separate field at the right of the front panel. These keys allow fast selection of function such as single or continuous burst/sweep; hold and external trigger/modulation; asymmetrical waveform with duty cycles variable from 1 to 99%; a 50% key for instant return to symmetrical waveforms, store and recall keys for up to 9 complete front-panel settings; the dial lock key to disable the control knob for numeric settings; and the Low Z_0 key on the PM 5139.

Selectable Output Impedance (PM 5139)

The 50 ohm output impedance is standard. The PM 5139 also has a low-impedance output mode selectable by a front panel button. The low output impedance makes the generator output voltage virtually insensitive to variations in the connected load impedance. With low impedance, the PM 5139 has the capability to deliver a full 20V p-p into a 50Ω load in lower frequency applications where back-matching is not critical.

Fast, Accurate Carrier Setting

A $4^1/_2$ digit frequency display with digit select and automatic range switching allows fast, accurate setting of the carrier frequency. Out-of-range settings, for example a 5 MHz ramp, are indicated by flashing of the related waveform and frequency display. Access to 10 Hz frequency resolution above 200 kHz is possible via the optional GPIB/IEEE-488.2* interface.

Wide Choice of Standard Waveforms

The PM 5138 is equipped with a broad library of 7 standard waveforms plus one user-defined arbitrary waveform. The PM 5139 has an extended waveform library offering 10 standard waveforms and 6 stored arbitrary waveforms. Selecting one of the 6 arbitrary waveforms takes less than 80 ms, and is done via the front panel control knob or remotely via the GPIB/IEEE-488.2 interface. This fast selection saves time in automated testing routines.

Setting AC Voltage and DC Offset

The ac voltage of both instruments can be set between 1 mV and 20V p-p. DC offset can be set independently of the ac level within a ±10V window. A dc offset indication is given in the bottom right corner of the display. This warning is important when the generator has a setting such as dc offset = 8V, ac = 10 mV p-p.

DC offsets may also be applied to arbitrary waveforms.

Wide Choice of Modulation Modes

Extensive modulation capabilities are a strong point of these generators. Modulation modes include AM, FM, PSK, burst, gating and linear or logarithmic frequency sweep. Full modulation capabilities are available for all types of waveforms, including arbitrary waveforms. The modulation source may be internal or external.

Both instruments have an internal modulation source; in the case of the PM 5139 this is programmable over the range 10 Hz to 100 kHz, which means that for many applications there is no longer any need for an external modulation source. On the PM 5138 the internal modulation frequency is fixed at 1 kHz, and external modulation sources from dc to 200 kHz can be used.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

PM 5138 & PM 5139

Versatile Burst and Sweep Modes

The burst mode allows a selectable number of cycles to be created at burst trigger frequencies over a 1 mHz to 100 kHz range (1 kHz only for the PM 5138). The lower trigger frequencies are particularly valuable for mechanical test applications, where intervals as long as 1,000 seconds can be achieved between test cycles. All waveforms, including arbitrary, can be sent as a burst. Frequency sweep mode covers a wide $9^1/_2$ decade frequency range, with both linear and logarithmic sweeps and variable sweep times from 10 ms to 999 seconds. Three different modes (sweep and flyback, sweep and hold, and sweep up and down) are provided. All waveforms, including arbitrary, may be swept.

Arbitrary Waveforms

Both the PM 5138 and PM 5139 offer a versatile 'arbitrary' waveform capability, which is a powerful aid to the generation of custom test signal in GPIB/IEEE-488 system environments. Arbitrary or user-defined waveforms can be created on a PC, and then downloaded to the PM 5138 or PM 5139 via the optional GPIB/IEEE-488.2 interface.

A waveform captured by a Digital Storage Oscilloscope can be transferred to a PC and modified using the PM 2273 AnyWave software package. This package is a powerful tool for creating, capturing and modifying the desired signals, and transferring them quickly and easily to the function generator.

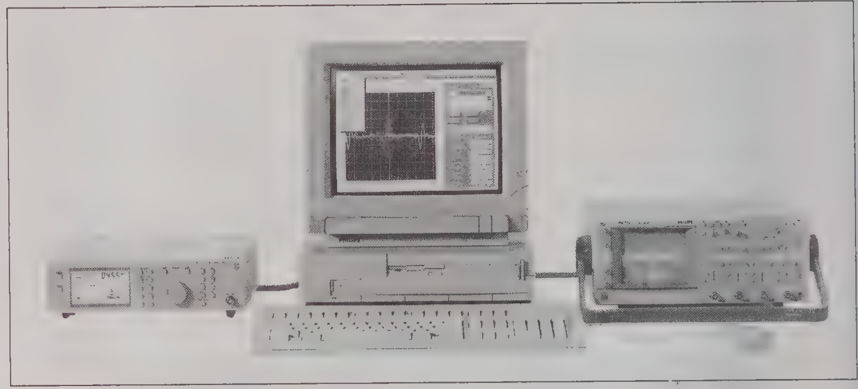
Alternatively, any desired waveform can be captured from a test system using a Fluke Digital Storage Oscilloscope, and then transferred to the PM 5138 or PM 5139 without the need for a PC. The amplitude and frequency of the captured waveform can be varied using the control knob of the function generator, and even modulation modes like AM, FM, gate, sweep and burst can be added to the captured waveform. This makes it very easy to generate a single shot in the arbitrary mode, or to sweep an arbitrary waveform.

There is no need to enter complex parameters; just select the modulation mode and parameters you want, or add a dc offset to the arbitrary waveform by selecting the dc offset function.

Optional GPIB/IEEE-488.2 Programmability

The PM 5138 and PM 5139 are optionally available with a factory-fitted GPIB/IEEE-488.2 interface that provides true system performance.

Carrier frequencies may be programmed over the bus with resolution of 10 Hz (in the upper two frequency ranges) providing the resolution required for systems applications. The built-in non-volatile memory for 9 complete front-panel settings can also be activated under remote control, which can speed and simplify the programming of frequency used test routines.



The IEEE and arbitrary versions of the PM 5138/39 are able to receive captured waveforms from a DSO directly, or from a PC running PM 2273 AnyWave software.

Specifications

Technical Specifications

Quick Selection Guide

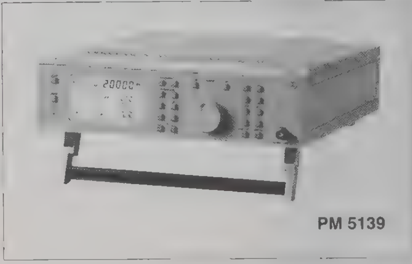
	PM 5138	PM 5139
Maximum Frequency	10 MHz	20 MHz
Standard Waveforms	7	10
Arbitrary Waveforms	1	6
Output Impedance	50Ω	50Ω low Z_0
Max. Output Level into 50Ω	10V p-p	20V p-p (low Z_0)
Internal Modulation/ Frequency	1 kHz	10 Hz 100 kHz
Burst Trigger Frequency Internal	1 kHz	1 mHz 100 kHz
Burst START STOP PHASE	0°	-180° to +180°

Frequency Characteristics		
	PM 5138	**PM 5139**
fmin	0.1 mHz	0.1 mHz
fmax	0.10 MHz	20 MHz

Nominal Range
PM 5138: 0.1 mHz to 10 MHz
PM 5139: 0.1 mHz to 20 MHz

Maximum Frequency		
	PM 5138	**PM 5139**
Sine	10 MHz	20 MHz
Square	10 MHz	20 MHz
Pos/neg pulse	10 MHz	20 MHz
Triangle	500 kHz	500 kHz
Pos/neg saw	50 kHz	50 kHz
Sine pulse	-	50 kHz
Triangle pulse	-	50 kHz
Haversine	-	50 kHz
Arb (1000 points)	20 kHz	20 kHz

Resolution: $4^1/_2$ digits, max. 0.1 mHz (10 Hz res, f_c <200.00 kHz via GPIB)



PM 5139 display with all segments on

Display: 4½ digits LCD
Setting Error: ±2 x 10^{-6} (±2 ppm)
Residual FM
PM 5138: <10 ppm, 1 ppm typical (f_c <5 MHz); <100 Hz, 13 Hz typical (f_c >5 MHz)
PM 5139: <10 ppm, 1 ppm typical (f_c <10 MHz); <100 Hz, 13 Hz typical (f_c >10 MHz)
Temperature Coefficient: <0.2 ppm/°C
Aging: <1 ppm/year
Drift: <0.3 ppm in 7 hours
Synchronization: By 10 MHz (or 10 MHz subharmonic) external clock

Output Characteristics

Main Output Connector: BNC socket on front panel
Output Impedance
PM 5138: 50Ω
PM 5139: 50Ω or low Z_0

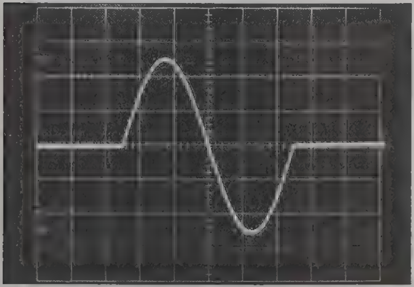
Low Z_0 Mode (PM 5139 only)
Output Level: ≥2V p-p
Impedance: 0.36 + 32 x (f_c/20 MHz)
Maximum Current: 250 mA peak
Frequency Range: As operational range, except for pos/neg pulse, <10 MHz
Load Capability: Short circuit proof

Output Amplitude (open circuit): 0.000 to 0.2000V p-p, resolution 1 mV; 0.20V p-p to 2.00V p-p, resolution 10 mV; 2.0V p-p to 20.0V p-p, resolution 100 mV
Basic Setting Error: ±2.5%, f_c <5 MHz

Amplitude Flatness 10 mV to 20V p-p
0.1 mHz to 200 kHz: ±0.03 dB typical
200 kHz to 5 MHz: ±0.07 dB typical
5 MHz to 10 MHz: ±0.1 dB typical
10 MHz to 20 MHz (PM 5139 only): ±0.4 dB typical
DC Voltage: Independent of ac setting within ±10V window
Range: -10 to +10V
Resolution: 0.1V
Error: ±2%
Offset Error: ±50 mV (at 50Ω load)

TTL Output (rear panel)
Fan-out: <10 TTL inputs (Z_0 = 50Ω)
Level: 0/5V

Waveforms



Symmetry (1% resolution)

Symmetry (duty cycle)
Range: 1% to 99%, f_c <20 kHz
Resolution: 1%
Waveforms: Sine, square, triangle and pos/neg rectangular pulses
Range: 20% to 80%, f_c <5 MHz
Resolution: 1%
Waveforms: Square and pos/neg rectangular pulses

Sine Wave
Frequency Range
PM 5138: 0.1 mHz to 10 MHz
PM 5139: 0.1 mHz to 20 MHz
Output Range: 0 to 20V p-p
Total Harmonic Distortion*2: <0.4%, 0.1% typical (f_c <500 kHz)

	PM 5138	PM 5139
Harmonics		
f_c <500 kHz	<-48 dBc	<-48 dBc
f_c <5 MHz	<-40 dBc	<-40 dBc
f_c <10 MHz	<-36 dBc	<-36 dBc
f_c <20 MHz	—	<-34 dBc
Subharmonics		
f_c <5 MHz	<-60 dBc	<-60 dBc
f_c <10 MHz	<-36 dBc	<-60 dBc
f_c <20 MHz	—	<-38 dBc
Nonharmonics		
f_c <5 MHz	<-37 dBc	<-37 dBc
f_c <10 MHz	<-37 dBc	<-37 dBc
f_c <20 MHz	—	<-37 dBc
Phase Noise (1 kHz dist.)		
f_c <5 MHz	<-80 dBc	<-80 dBc
f_c <10 MHz	<-80 dBc	<-80 dBc
f_c <20 MHz	—	<-80 dBc

Square Wave
Frequency Range
PM 5138: 0.1 mHz to 10 MHz
PM 5139: 0.1 mHz to 20 MHz
Output Range: 0 to 20V p-p

Transition Times

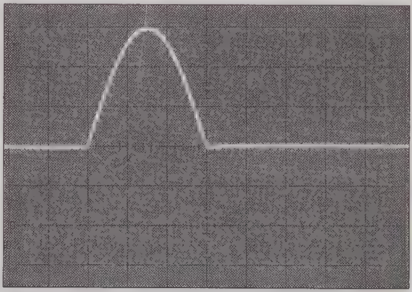
	PM 5138	PM 5139
f_c ≤500 kHz	≤30 ns	≤30 ns
f_c >500 kHz	≤20 ns	≤20 ns

Symmetry: 1% to 99%, resolution 1%, f_c <20 kHz; 20% to 80%, resolution 1%, f_c <5 MHz
Aberration: <2%

Triangle Wave
Frequency Range: 0.1 mHz to 500 kHz
Output Range: 0 to 20V p-p
Linearity Error: <0.2% (f_c <20 kHz)
Symmetry: 1% to 99%, resolution 1%, f_c <20 kHz

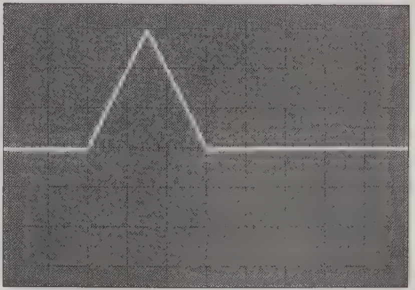
Sawtooth (positive/negative ramps)
Frequency Range: 0.1 mHz to 50 kHz
Output Range: 0 to 10V p-p
Linearity: <0.2% (f_c <20 kHz)

Rectangular Pulses
Frequency Range
PM 5138: 0.1 mHz to 10 MHz
PM 5139: 0.1 mHz to 20 MHz
Output Range: 0 to 10V p-p
Transition Time: "See Square Wave"
Symmetry: 1% to 99%, resolution 1%, f_c <20 kHz; 20% to 80%, resolution 1%, f_c <5 MHz
Aberration: <2% (AC p-p >100 mV)



Sine Pulse (PM 5139 only)

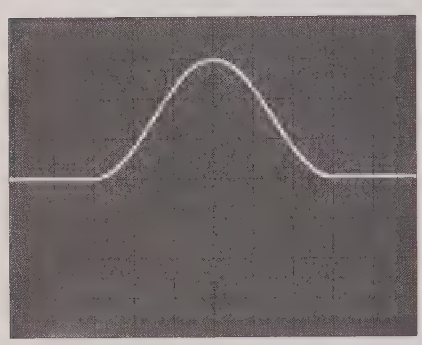
Sine Pulse (PM 5139 only)
Frequency Range: 0.1 mHz to 50 kHz
Output Range: 0 to 10V p-p



Triangle Pulse (PM 5139 only)

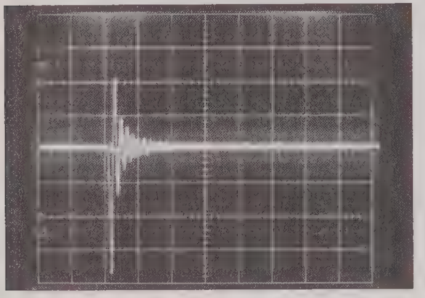
Triangle Pulse (PM 5139 only)
Frequency Range: 0.1 mHz to 50 kHz
Output Range: 0 to 10V p-p

PM 5138 & PM 5139



Haversine (PM 5139 only)

Haversine (PM 5139 only)
Frequency Range: 0.1 mHz to 50 kHz
Output Range: 0 to 10V p-p



Arbitrary Waveform (user defined)

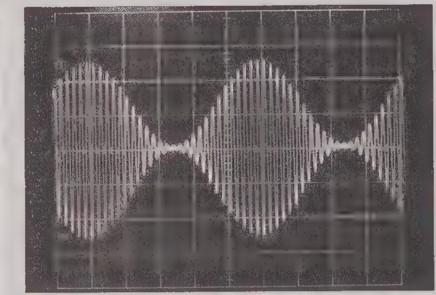
Arbitrary*1
Frequency Range (for a waveform of 1024 samples): 0.1 mHz to 20 kHz
Maximum Sample Frequency: 20.48 MHz
Sample Addresses (x): 1024 (10 bits) fixed
Sample Levels (y): 1024 (10 bits)
Programmable: Via IEEE-488.2 with a PC or direct with a DSO without a PC

Modulation

Modes: AM int/ext, FM int/ext, PSK int/ext, gate int/ext, sweep int/ext, burst int/ext

Internal Modulation Source

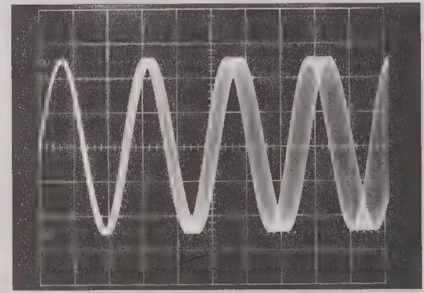
PM 5138:	1 kHz fixed	(±0.01%)
PM 5139:	10 Hz to 100 kHz 0.001 to 0.100 Hz; 0.10 to 1.00 Hz; 1.0 to 10.0 Hz; 10 to 100 Hz; 0.10 to 1.00 kHz; 1.0 to 100.0 kHz;	(±0.01%) res. 1 mHz res. 10 mHz res. 100 mHz res. 1 Hz res. 10 Hz res. 100 Hz



AM

Internal AM
Carrier Frequency
PM 5138: 0.1 mHz to 10 MHz
PM 5139: 0.1 mHz to 20 MHz
Carrier Waveforms: All including arbitrary*1
Modulation Frequency
PM 5138: 1 kHz
PM 5139: 10 Hz to 100 kHz
Modulation Depth: 0 to 100%, resolution 1%

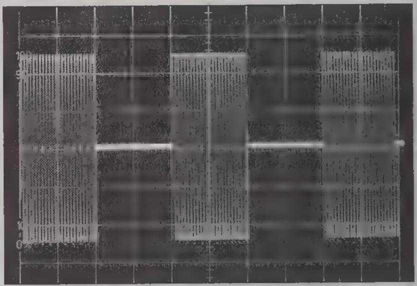
External AM
Modulation Frequency: 0 to 200 kHz
Modulation Depth: 0 to 100%



FM or sweep

Internal FM
Carrier Frequency
PM 5138: 0.1 mHz to 10 MHz
PM 5139: 0.1 mHz to 20 MHz
Carrier Waveforms: All including arbitrary*1
Modulation Frequency
PM 5138: 1 kHz
PM 5139: 10 Hz to 100 kHz
Deviation: 0 to 2%, resolution 0.01%

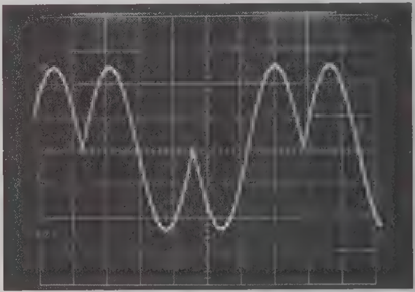
External FM
Carrier Frequency
PM 5138: 0.1 mHz to 10 MHz
PM 5139: 0.1 mHz to 20 MHz
Modulation Frequency: 10 Hz to 200 kHz
Deviation: 0 to 2%



GATE: non-phase coherent signal keying

Internal Gate
Non-phase coherent signal keying
Carrier Frequency
PM 5138: 0.1 mHz to 10 MHz
PM 5139: 0.1 mHz to 20 MHz
Carrier Waveforms: All including arbitrary*1
Modulation Frequency
PM 5138: 1 kHz
PM 5139: 10 Hz to 100 kHz
Duty Cycle: 50%

External Gate
Modulation Frequency: 0 to 200 kHz (TTL signal)



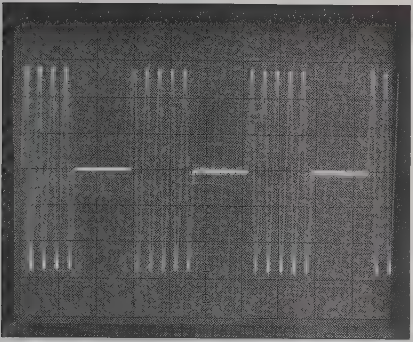
PSK phase shift keying

Internal PSK
Phase shift keying (0/π)
Carrier Frequency
PM 5138: 0.1 mHz to 10 MHz
PM 5139: 0.1 mHz to 20 MHz
Carrier Waveforms: Sine, square,and triangle
Modulation Frequency
PM 5138: 1 kHz
PM 5139: 10 Hz to 100 kHz
Duty Cycle: 50%

External PSK
Modulation Frequency: 0 to 200 kHz (TTL signal)

**1 Instruments with IEEE*

PM 5138 & PM 5139



Burst with start/stop phase

Internal Burst
Phase coherent signal keying
Carrier Frequency: 0.1 mHz to 2 MHz
Carrier Waveforms: All including arbitrary*1
On Cycles: 1 to 2000
Start Phase (PM 5139): -180° to +180° for sine and triangle, $f_c < 20$ kHz; 0° for other waveforms
Trigger Frequency
PM 5138: 1 kHz
PM 5139: 1 mHz to 100 kHz
Burst Function: Single shot with "SINGLE" key or continuous via internal trigger source

External Burst
Trigger Frequency: 0 to 200 kHz

Sweep
Carrier Waveform: All including arbitrary*1
Sweep Functions: Linear or logarithmic/single or continuous
Sweep Range

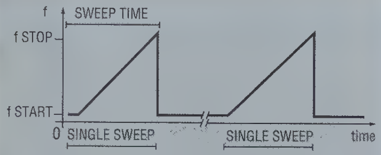
	PM 5138	PM 5139
Range I	1 mHz to 5 MHz	1 mHz to 10 MHz
Range II	50 kHz to 10 MHz	50 kHz to 20 MHz

Sweep Modes: I: sweep and fly-back; II: sweep and hold; III: sweep and reverse sweep
Sweep Time: 0.01s to 1000s in 3 ranges, max resolution 10 ms
Triggering: Via front panel key "SINGLE" or "CONTINUOUS", or via modulation/trigger input at rear side, or via IEEE bus

IEEE-488 Bus Remote Control

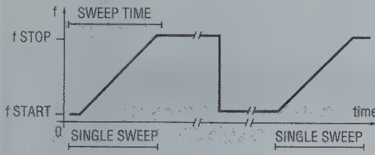
Control Capability: All functions and characteristics
Interface Functions: AH1, L3, SH1, T6, SR1, RL1
Address: Programmable with rotary knob on front panel
Address Range: 0 to 30 and listen only mode
Remote Lock-out: Go to local via front panel key "LOCAL"
Special Functions: Device identification mode/learn mode

Mode 1



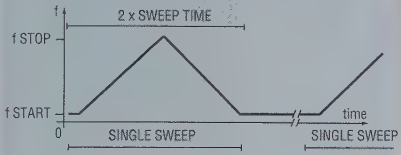
SINGLE: Sweep starts at f_{START} runs to f_{STOP} flies back to f_{START}

Mode 2



SINGLE: Sweep starts at f_{START} runs to f_{STOP} remains at f_{STOP}. Pressing SINGLE again resets the sweep to f_{START}.

Mode 3



SINGLE: Sweep starts at f_{START} runs to f_{STOP} runs to f_{START} (in the same time as from f_{START} to f_{STOP}

General Specifications

Non-Volatile Memory
Instrument Settings: 10
Arbitrary Waveforms*1
PM 5138: 1
PM 5139: 6
Rear Connectors: Modulation/triggering input/reference input/TTL output/modulation output/penlift output/sweep output/10 MHz reference output/IEEE bus connector*1/power connector

Operating Conditions

Reference Temperature: 23°C ±1°C
Operating Temperature: +5°C to +40°C
Storage Temperature: -40°C to +80°C
EMI: Meets requirement of VDE 0871 Class B
Safety: Meets requirement of IEC 348 Class 1
Voltage: 100V, 120V, 220V, 240V
Line Frequency: 50 Hz to 60 Hz ±5%

Power Consumption
PM 5138: 42W
PM 5139: 58W

Mechanical Data

Size: 105 mm H x 315 mm W x 405 mm D (4.1 in H x 12.4 in W x 15.9 in D)
Weight: 6.7 kg (15.4 lb)

Ordering Information

Models

PM 5138/00n 10 MHz Function Generator
PM 5138/02n 10 MHz Function Generator with GPIB
PM 5139/00n 20 MHz Function Generator
PM 5139/02n 20 MHz Function Generator with GPIB

Power Options
The last digit of the type number is the indication for the local line voltage and local line cord. Following line voltage settings plus line cord are available.

n=1	Universal European 220V
n=3	Standard North American 120V
n=4	United Kingdom 240V
n=5	Switzerland 220V
n=8	Australia 240V

Included with Instrument
One-year product warranty, line cord, Operator's manual and Certificate of Calibration Practices.

Accessories
PM 2255 Instrument Drivers
PM 9051 BNC to 4 mm Banana Adapter
PM 9563 19" Rack Mount
PM 9581/01 50Ω Feedthrough, 3W
PM 9585/01 50Ω Feedthrough, 1W

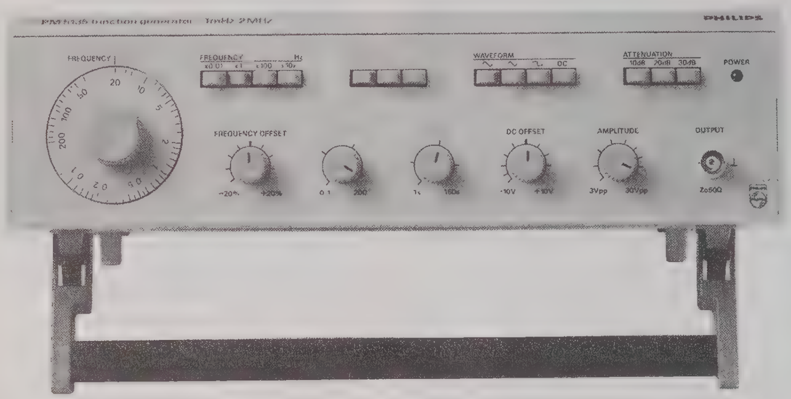
Manuals
PM 5138 Operator*
PM 5138 Service
PM 5139 Operator*
PM 5139 Service
PM 5139 Programming Card
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

PM 5135



PM 5135

PM 5135 2 MHz Function Generator

- Frequency range 1 mHz to 2 MHz in 4 sub-ranges
- Pushbutton-selectable sine, square and triangle waveforms
- Single and continuous logarithmic sweeps
- Continuously adjustable sweep period
- External sweep mode (VCO) facility
- 30 Vp-p maximum output
- Attenuation 0 to 60 dB in 10 dB steps and 0 to 20 dB variable
- DC offset variable from -10 to +10V

Thanks to its easy operation, complete specifications and modern, ergonomic design, the PM 5135 is an ideal low-cost function generator for many different purposes. The wide 1 mHz to 2 MHz frequency range, versatile sweep functions, and easily adjustable dc offset and attenuation settings allow the PM 5135 to meet virtually every requirement in general-purpose use.

With its clear and logical panel design, the PM 5135 is very simple to use, making it an excellent choice for education and training, as well as for many general-purpose applications like audio and electronics service, production testing and development labs.

Fast, Accurate Setting

Setting-up the PM 5135 is done very quickly. Frequency selection is by pushbuttons for four decade ranges, with a large logarithmic dial plus a frequency offset control with a range of ±20% of the dial setting. Standard sine, triangle and square waveforms are pushbutton-selectable. Duty cycle is a standard 50%. DC offset can be added within a ±10V range, or an offset dc voltage can be produced without any ac component.

Versatile Sweep Functions

The PM 5135's versatile sweep functions are ideal for more advanced test applications. Sweeps can be single or continuous, with a logarithmic characteristic and the stop frequency can be set independently from the start frequency. The sweep range of 3$^1/_2$ decades is ideal for audio band sweeps from 10 Hz - 20 kHz. Sweep period is continuously adjustable over a wide range - from 1 second up to 150 seconds. Sweeps can be triggered manually by pushbutton control, or from an external trigger source. An external sweep facility (VCO mode) is also provided.

Wide Output Range

The PM 5135 has a wide attenuation range, allowing many different loads to be driven optimally. Pushbutton-selectable attenuation covers the range 0 to 60 dB in 10 dB steps, or alternatively a continuously variable adjustment is available over a 0 to 20 dB range (equivalent to 3 Vp-p to 30 Vp-p). The PM 5135's output is fully short-circuit proof, ensuring constant, reliable performance under tough everyday operating conditions.

Specifications

Technical Specification

Frequency Characteristics

Normal Range: 1 mHz - 2 MHz
Selectable Ranges: I 1 mHz to 2 Hz
II 100 mHz to 200 Hz
III 10 Hz to 20 kHz
IV 1 kHz to 2 MHz
Indication: Dial, with logarithmic scale
Setting Accuracy: <±10% of indicated frequency
Vernier Frequency Control: -20% to + 20% of frequency setting
Temperature Coefficient: <5 x 10^{-3}/K
Short Term Drift (t<15 min): <1.5 x 10^{-2}
Long Term Drift (t<7 hours): <3 x 10^{-2}

Waveforms

Standard Waveforms:
Sine wave
Square wave } with or without DC offset
Triangle wave
DC voltage without AC

Duty Cycle

Fixed: 50%
Wave Forms: All

Output

Main Output: BNC connector front panel
Attenuation Fixed: 10, 20, 30 to 60 dB in 10 dB steps
Impedance: 50Ω
Short Circuit Proof: Yes
Protection: Withstands ext dc ±10V maximum

AC Voltage

Maximum Open Circuit Voltage: 30 Vp-p
Attenuation Variable: 20 dB

DC Voltage

Offset Voltage: -10 to +10V (open output)

TTL

Residual: <50 mV
Output: BNC connector rear panel
Duty Cycle: As main output
Fan Out: 10 TTL inputs

Sine Wave

THD: Range I, II, III <0.5%, Range IV <3%
Frequency Response of Amplitude Relative to 1 kHz (Range III):
Range I <0.2 dB
Range II, III <0.1 dB
Range IV <0.3 dB (1 kHz to 1 MHz)
<1.0 dB (1 MHz to 2 MHz)

Triangle

Triangle Wave Linearity: Range I, II, III >99%
Range IV >98%

Square Wave (into 50Ω)

Rise and Fall Time: <70 ns
Overshoot, Ringing: <2%

Sweep Internal Facilities

Sweep Internal Characteristic: Logarithmic
Maximum Sweep Range: $3^{1}/_{2}$ decades (within selected range)
Modes: Single/continuous
Sweep Time: 1 to 150 sec.
Triggering: Via front panel key "Trig" or "Cont", or via trigger input at rear panel
Control Functions: On/Cont/Trig
Sweep Voltage Output: BNC connector rear panel

Sweep External Facilities

Sweep External Characteristic: Logarithmic
Voltage vs Frequency Characteristic: 1V/decade
Maximum Sweep Range: $3^{1}/_{2}$ decades
Sweep Input: BNC connector rear panel
Ext Trigger Input: BNC connector rear panel

Power Requirements

Voltage:
$\left.\begin{array}{l}100\text{ to }120\text{ V}\\200\text{ to }240\text{ V}\end{array}\right\}\pm10\%$
Power Consumption: 33 VA
Frequency: 47.5 to 66 Hz
Indication: Led on front panel
Switching: Switch on rear panel
Safety: Meets requirements of IEC 348, class I

Operation Conditions

Reference Temperature: 23 °C + 1°C
Operation: + 5 to + 40 °C
Storage: -40 to + 70°C

Mechanical Data

Size: 105 mm H x 315 mm W x 405 mm D (4.1 in H x 12.4 in W x 15.9 in D)
Weight: 3.8 kg (8.4 lb)

Ordering Information

Model

PM 5135/00n Function Generator
n see power options

Included with Instrument
Operating manual, line cord, one-year product warranty.

Power Options
The last digit (n) of the type number PM 5135 is the indication for the local line voltage and local line cord. Following line voltage settings plus line cord are available:
n = 1 Universal European 220V
n = 3 Standard North American 120V
n = 4 United Kingdom 240V
n = 5 Switzerland 220V
n = 8 Australia 240V
Example: PM 5135/001 2 MHz Function Generator, Universal European line voltage

Accessories (Also see Section 20)
PM 9581/01 50Ω Feedthrough Termination 3W
PM 9585/01 50Ω Feedthrough Termination 1W
PM 9051 Adaptor BNC/4 mm
PM 9075 Coaxial Cable BNC-BNC
PM 9551 50Ω to 600Ω Adapter

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

PM 5134

PM 5134

PM 5134 20 MHz Function/Sweep Generator

- Sine, square, and triangle waveforms, plus positive/negative pulses, dc
- 0.001 Hz to 20 MHz frequency range in 7 sub-ranges
- 20V p-p output and separate TTL output
- Normal or high accuracy crystal controlled operation
- Internal or external linear sweep and AM/FM modulation facilities
- Burst and single-cycle with variable start phase
- Stepped and variable attenuation over 60 dB range

The PM 5134 is an easy-to-use, yet extremely sophisticated function generator embodying an wide range of facilities in a single instrument.

It will produce sine, square and triangle waveforms as well as positive and negative pulses and dc. The duty cycle is variable between 10% and 90%.

The wide 1 MHz to 20 MHz frequency range is divided into 10 sub-ranges, which are selected by means of a rotary switch with an overriding coarse/fine adjustment. This fine adjustment, combined with the $3^{1}/_{2}$ digit LED display, gives an immediate, highly accurate readout of the selected frequency. Set-up procedures are greatly simplified compared with the traditional dial setting, and any errors (such as parallax) are eliminated.

In addition, the $3^{1}/_{2}$ digit display can be used to monitor the open-circuit output voltage by depressing a pushbutton. Also, when used in the sweep mode, the start, stop and run frequencies are indicated by separate LEDs. An error warning lamp automatically indicates any incompatible set-up conditions.

Crystal-Controlled Accuracy

The high nominal accuracy (see technical specification) of ±2% ±1 digit, can be further improved to ±5 x 10^{-6} by operating the instrument in the crystal-controlled mode. This facility is useful, for example, for identical repetitive measurements requiring high accuracy, or for narrow band filter tests.

The continuously variable 20V p-p max output (10V p-p pulses) is available at the front-panel mounted socket; there is a pushbutton choice of 600Ω or 50Ω output impedance. Output attenuation is selectable in any combination of 3-6-10-20 dB pushbuttons with an overriding continuous 20 dB control.

Sweep and AM/FM Modulation

The linear Sweep facilities include single and continuous operation. The single sweep can be triggered either manually, or electronically from an external source. The sweep period is continuously adjustable between 5 ms and 100s. The START and STOP frequencies can be set independently of each other. A HOLD facility allows a sweep to be stopped at any desired frequency useful for checking phenomena occurring during a sweep by means of a pushbutton. An interrupted sweep is continued by simply releasing the HOLD button. If required a sweep can be reset to the start frequency using the RESET pushbutton.

The generator offers an internally or externally controlled burst or single-cycle signal. The start/stop phase is continuously adjustable between -90° and +90°.

The internal AM is adjustable between 0 and 100% modulation depth. The modulation frequency can be set over a wide range from 10 MHz to 20 kHz. The AM facility can be used with crystal control, if desired. External AM inputs in the range from dc to 20 kHz can be applied via a rear-mounted BNC-socket.

The internal FM can be adjusted, continuously, between zero and ±10% frequency deviation.

Other input/output facilities available on the rear panel include a TTL output and pen-lift control.

The design of the PM 5134 has resulted in a clean, simple front panel layout which allows the operator to quickly become familiar with all control functions very quickly. Its overall versatility makes it suitable for a very wide range of applications within research design or educational organizations. The instrument also occupies minimal bench space and is short-circuit proof.

Specifications

Technical Specifications

Frequency Characteristics

Nominal Range: 1 MHz to 20 MHz

Display: $3^{1}/_{2}$ digits; 7-segment LED; 4-dimension LEDs MHz, Hz, kHz, MHz

Setting Error: ±2% ±1 digit (1 MHz to 2 MHz) ±5% ±1 digit (2 MHz to 20 MHz); for crystal mode, ±5 x 10^{-6}

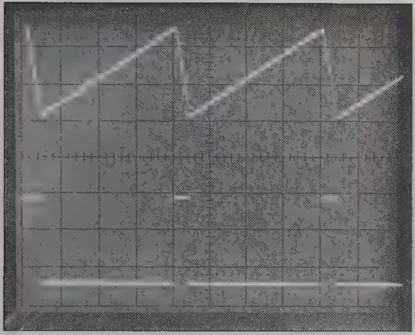
Temperature Coefficient: <1.0 x 10^{-3}/K (20 MHz range excluded); crystal mode, <2 x 10^{-6}/K

Short Term Drift: (<15 min); <1 x 10^{-3} (1 MHz to 2 MHz); <4 x 10^{-3} (2 MHz to 20 MHz); for crystal mode, <1 x 10^{-6}

Long Term Drift: (<7h); <3 x 10^{-3} (1 mHz to 2 MHz); for crystal mode, <5 x 10^{-6}

Duty Cycle: 50% fixed; 10% to 90% continuously variable (20 MHz range excluded)

PM 5134



Variable duty cycle shown in triangular and square wave signals.

Waveforms: Sine wave, square wave, triangular wave, positive pulse, negative pulse (all waveforms with or without dc offset), dc voltage without ac

Output

AC Voltage

Max Open Circuit Voltage: 20V p-p (10V p-p for pulse)
Indication Open Circuit Output Voltage: Alt. mode frequency display
Attenuation: 3, 6, 10, 20 dB calibrated steps selectable in any combination plus 20 dB continuously adjustable
Impedance: 50Ω or 600Ω selectable
Short-Circuit Proof: Yes

DC Voltage

Offset Voltage: -5V to +5V (open circuit)

Sine Wave

Total Harmonic Distortion
Range 1-3 (1 mHz to 2 Hz): <30%
Range 4-7 (1 Hz to 20 kHz): <0.5%
Range 8 (10 kHz to 200 kHz): <1.0%
Range 9 (100 kHz to 2 MHz): <3.0%
Range 10 (1 MHz to 20 MHz): all harmonics more than 26 dB below the fundamental
Frequency Response of Amplitude
Range 1-2 (1 mHz -200 mHz): <0.5 dB
Range 3-8 (0.1 Hz -200 kHz): <0.1 dB
Range 9 (100 kHz -2 MHz): <0.5 dB
Range 10 (1 MHz -20 MHz): <1.5 dB
Maximum amplitude into 50Ω

Triangle Wave

Linearity: >99% (<100 kHz)

Square Wave

Rise and Fall Time: <18 ns (into 50Ω)
Overshoot and Ringing: <3% (into 50Ω)

Positive/Negative Pulses

See Square Wave above

TTL

Duty Cycle: As main output
Fan Out: 5 TTL inputs
Level: High >2.4V; low <0.8V

Pen Lift

BNC socket at rear

Sweep Facilities

Internal Sweep

Characteristics: Linear
Max Sweep Range: 2 decades
Mode: Single or continuous
Indication: $3\frac{1}{2}$ digits, 7-segment LED; 3 LEDs STOP, RUN and START
Period Time: 5 ms to 100s continuouly adjustable in 4 sub-ranges
Control Functions: HOLD, RESET, TRIG (manually) and electronic triggering
Sweep Output Voltage at Modulation Output: 0V to 5V (dependent on start and stop frequency)

External Sweep/FM (VCO)

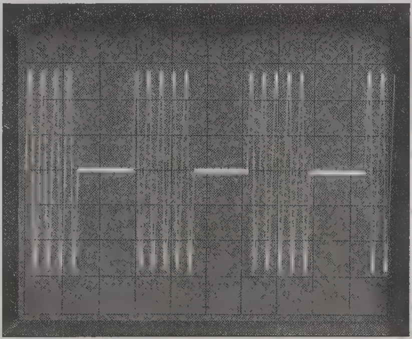
Input: BNC socket at rear
Characteristics: Linear
Voltage vs. Frequency Characteristic: 1V/0.2 max frequency of selected subrange
Max Sweep Range: $2\frac{1}{2}$ decades for subranges above 2 Hz
Input Resistance: 5 kΩ
Max Sweep Rate: 200 Hz ($1\frac{1}{2}$ decades range)
Sweep Voltage: Sawtooth, duty cycle 90%

Burst Facilities

Internal Burst

Continuous Operation
On/off Ratio: Approximately 1:1 (last cycle ends at START-PHASE level)
Repetition Time: 0.05 ms to 100s continuously adjustable in 6 sub-ranges

Single Operation
Duration: See Continuous Operation, Repetition time

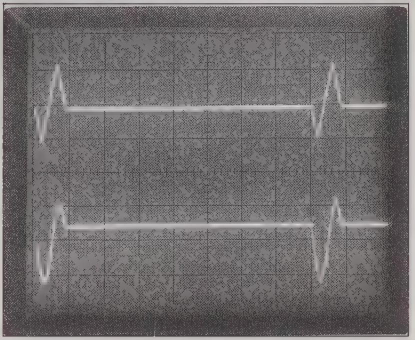


Burst signal.

Triggering: Manually or electronically via TRIG & BURST input
Start Phase: -90° to +90° ($-\pi/2$ to $+\pi/2$), continuously adjustable

External Burst

Input: TRIG & BURST
Control Voltage: TTL-level
Start: Low/High-transition
Stop: High/Low-transition, (when output signal reaches START-PHASE)
Max Control Frequency: 2 MHz
Start Phase: -90° to +90°($-\pi/2$ to $+\pi/2$), continuously adjustable

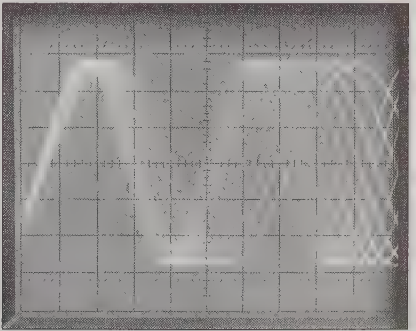


Repetitive single sine wave and triangle shown with different start phase.

Single Shot Facilities

Triggering

Manual: With pushbutton "TRIG"
External: Via "TRIG & BURST" rear panel BNC connector or internal repetitive



Frequency sweep or frequency modulation.

Modulation

FM, Internal

Modulation Waveform: Sine wave
Deviation: Approximately 0% to 10%; continuously adjustable
Modulation Frequency: 0.01 Hz to 20 kHz, continuously adjustable in 6 sub-ranges
Modulation Voltage: 3V p-p available
Output: Rear panel BNC connector

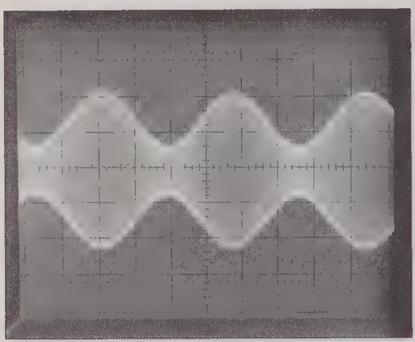
FM, External

Input: "SWEEP/FM" rear panel BNC connector

AM, Internal

Modulation Waveform: Sine wave
Modulation Depth: 0% to <100%; continuously adjustable
Modulation Frequency: See internal FM
Modulation Voltage: See internal FM

PM 5134



Carrier wave with AM modulation

AM, External
Input: AM, BNC socket at rear
Modulation Waveform: Arbitrary with spectral components up to 20 kHz
Modulation Depth: 0% to <100%; continuously adjustable
Modulation Frequency: DC to 20 kHz
Modulation Voltage: 2V p-p for 50% AM

Crystal Mode

Frequency Lock: Freezes the momentary frequency display (frequency setting inhibited)
Accuracy: ±5 x 10^{-6}

Crystal AM Mode

See crystal mode with additional facilities of internal and external AM

General Specifications

Power Requirements

Voltage: 110V, 128V, 220V, 238V ±10%
Power Consumption: 55W
Frequency: 50/60 Hz

Operating Conditions

Reference Temperature: +23°C ±1°C
Operating: +5°C to +40°C
Storage and Transportation: -40°C to +70°C

Mechanical Data

Size: 310 mm W x 140 mm H x 390 mm L (12.2 in W x 5.15 in H x 15.4 in L)
Weight: 6.5 kg (14.3 lb)

Ordering Information

Model

European Version
PM 5134 Function Generator

U.S. Version
PM 5134M Function Generator

Included with Instrument
One-year product warranty, line cord, instruction manual, and Certificate of Calibration Practices.

Accessories (Also see Section 19)
PM 9051 Adapter BNC/4 mm
PM 9075 Coaxial Cable BNC
PM 9560 19" Rack Mount Adapter
PM 9581/01 50Ω/3W Termination

Manual
PM 5134 Instruction*

No charge with purchase of unit

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

PM 5133

PM 5133 function generator 10 mHz-2 MHz
PHILIPS
0 1 2 3
ATTENUATION
DC OFFSET PUSH FOR ZERO
DUTY CYCLE

PM 5133

PM 5133 Function Generator

- Sine, square, and triangular waveforms, positive/negative pulses, dc
- 0.01 Hz to 2 MHz frequency range in 7 sub-ranges
- 20V p-p output and separate TTL output
- Logarithmic or linear sweep with manual and electronic sweep trigger
- Internal or external sweep facility
- Single and burst with variable start phase
- Frequency and open circuit output voltage indicated on 3½ digit LED display

The versatile PM 5133 function generator offers both linear and logarithmic sweep facilities in addition to a wide range of other features. Outputs include sine, triangle and square waveforms as well as positive or negative pulses, and dc. The duty cycle is variable between 10% and 90%.

The wide frequency range of 10 mHz to 2 MHz is selected by means of a 7-position rotary switch with an overriding coarse/fine adjustment. A 3½ digit LED display provides accurate, clearly readable setting information and eliminates those human errors (such as parallax) likely to occur with more conventional mechanical dials. The display is also used to monitor the open-circuit output voltage, sweep limit values and incompatible set-up conditions.

The output voltage (20V p-p max, except for pulses at 10V p-p max) is available at the front-panel mounted socket; there is also a pushbutton choice of 50Ω or 600Ω output impedance. Output attenuation of more than 80 dB is selectable in any combination of calibrated steps of 3-10-20-30 dB with an overriding 20 dB continuous control. The output voltage level can be checked by simply depressing a pushbutton, and can be read on the LED display.

Linear or Logarithmic Sub-Ranges

Sweep facilities include single-shot and continuous operation, with the choice of linear or logarithmic mode. Frequency ranges are divided into either seven linear or five logarithmic sub-ranges with continuous coarse and fine adjustment. The logarithmic sweep ranges cover more than four decades, making the instrument extremely useful for sweeping within the audio range.

The single sweep can be triggered either manually or electronically from an external source. The sweep period is continuously adjustable between 5 ms and 100s. The START and STOP frequencies can be set independently of each other. Also, a HOLD facility allows a sweep to be stopped at any desired frequency – useful for checking phenomena which may appear during a sweep – by means of a pushbutton.

An interrupted sweep is continued by simply releasing the HOLD button. Again, if required, a sweep can be reset back to the start frequency using the RESET button. When used in the sweep mode, the start, stop and run frequencies are all indicated clearly on separate LEDs.

An error warning LED automatically flashes in the event of any incompatible setting made by the operator.

The generator also offers an internally or externally controlled burst, or single waveform signal, having a continuously adjustable start/stop phase, -90° and +90°.

Other input/output facilities available at the rear panel include a TTL output and pen-lift control, internal modulation voltage and frequency control voltage.

The PM 5133 is designed for maximum electrical and mechanical protection. Careful attention has been given to ergonomic considerations, making the instrument easy to use. Its overall versatility makes it suitable for use within a wide range of applications such as research, design, education and manufacturing. It occupies minimal bench space and is short-circuit proof.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 10 MHz to 2 MHz
Display: 3½ digits, 7-segment LED, 4 dimension LEDs MHz, Hz, kHz, MHz
Setting Error: ±2% ±1 digit (10 MHz to 200 kHz); ±3% ±1 digit (200 kHz to 2 MHz)
Temperature Coefficient: <1.0 x 10^{-3}/K (linear mode); <2.5 x 10^{-3}/K (log mode)
Short Term Drift: (<15 min); <1 x 10^{-3} (10 MHz to 20 kHz); <3 x 10^{-3} (20 kHz to 2 MHz)
Long Term Drift: (<7h); <3 x 10^{-4}
Duty Cycle: 50% fixed; <10% to <90% continuously variable

Waveforms

Sine wave
Square wave
Triangular wave
Positive pulse
Negative pulse
} with or without dc offset
DC voltage without ac

Output

AC Voltage
Max Open Circuit Voltage: 20V p-p (10V p-p for pulse)
Indication: LED

PM 5133

Attenuation: 3, 10, 20, 30 dB calibrated steps selectable in any combination plus 20 dB continuously adjustable
Impedance: 50Ω or 600Ω selectable
Short-Circuit Proof: Yes

DC Voltage

Offset Voltage: 0V to ±5V (open circuit)

Sine Wave

Total Harmonic Distortion: <0.5% (10 MHz to 200 kHz); <2% (200 kHz to 2 MHz)
Frequency Response of Amplitude: <0.1 dB (10 MHz to 20 kHz); <0.3 dB (20 kHz to 1 MHz); <1.0 dB (1 MHz to 2 MHz) (max amplitude)

Triangle Wave

Linearity: <99% (10 MHz to 100 kHz)

Square Wave

Rise and Fall Time: <60 ns
Overshoot and Ringing: <2% (max amplitude into 50Ω)

Positive/Negative Pulses

See square wave

TTL

Duty Cycle: As main output
Fan Out: 20 TTL inputs

Sweep Facilities

Internal Sweep

Characteristics: Linear or logarithmic
Max Sweep Range: $2\frac{1}{2}$ decades (linear mode) $4\frac{1}{2}$ decades (logrithmic mode)
Mode: Single or continuous
Indication: $3\frac{1}{2}$ digits, 7-segment LED, 3 LEDS STOP, RUN and START
Period Time: 5 ms to 100s; continuously adjustable in 4 sub-ranges
Control Functions: HOLD, RESET, TRIG (trigger manually and electronically)
Internal Modulation BNC Output: 0V start frequency; 5V stop frequency
Frequency Control Voltage BNC Output: 0V to 5V (depending on start- and stop-frequency)

External Sweep/FM

Input: SWEEP/FM
Characteristic: Linear or logarithmic
Linear Characteristic: 1V/0.2 max frequency
Logarithmic Characteristic: 1V/frequency decade
Max Sweep Range: $2\frac{1}{2}$ decades (linear mode); $4\frac{1}{2}$ decades (log mode)
Input Resistance: 5 kΩ
Max Sweep Rate: 20 kHz at $1\frac{1}{2}$ decade log. 4 kHz at $1\frac{1}{2}$ decade lin
Sweep Voltage: Sawtooth, duty cycle 90%
Pen Lift Output: BNC socket at the rear side; electronic switch, closed during the sweep, open during fly-back

max. current: 200 mA output voltage: <0.7V	} electronic switch closed
output voltage: +20V internal resistance: 100 kΩ	} electronic switch open

Burst Facilities

Internal Burst

Continuous Operation

On/Off-Ratio: Approx 1:1 (last cycle ends at START-PHASE level)
Repetition Time: 5 ms to 100s; continuously adjustable in 4 sub-ranges

Single Operation

Repetition Time: See internal burst
Triggering: Manually or electronically via TRIG & BURST input
Start Phase: -90° to +90° ($-\pi/2$ to $+\pi/2$), continuously adjustable

External Burst

Input: TRIG & BURST
Control Voltage: TTL-level
Start: Low/high-transition
Stop: High/low transition; (when output signal reaches start phase)
Max Control Frequency: 2 MHz
Start Phase: -90° to +90° ($-\pi/2$ to $+\pi/2$), continuously adjustable

Single Facilities

Internal Single

Repetitive Mode: Same as internal burst
Single Triggering: Same as internal burst
Start Phase: -90° to +90° ($-\pi/2$ to $+\pi/2$), continuously adjustable

External Single

Input: TRIG & BURST; rear panel BNC input

General Specifications

Power Requirements

Voltage: 110V, 128V, 220V, 238V ±10%
Power Consumption: 38W
Frequency: 50/60 Hz

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C to +40°C
Limits of Storage and Transportation: -40°C to +70°C

Mechanical Data

Size: 310 mm W x 140 mm H x 390 mm L (12.2 in W x 5.5 in H x 15.4 in L)
Weight: 5.8 kg (14.3 lb)

Ordering Information

Models

PM 5133M Function Generator

Included with Instrument
One-year product warranty, instruction manual, and Certificate of Calibration Practices.

Accessories (Also see Section 19)
PM 9051 Adapter BNC/4 mm
PM 9075 Coaxial Cable BNC
PM 9560 19-in Rack Mount Adapter
PM 9581/01 50Ω/3W Termination

Manual
PM 5133 Instruction*

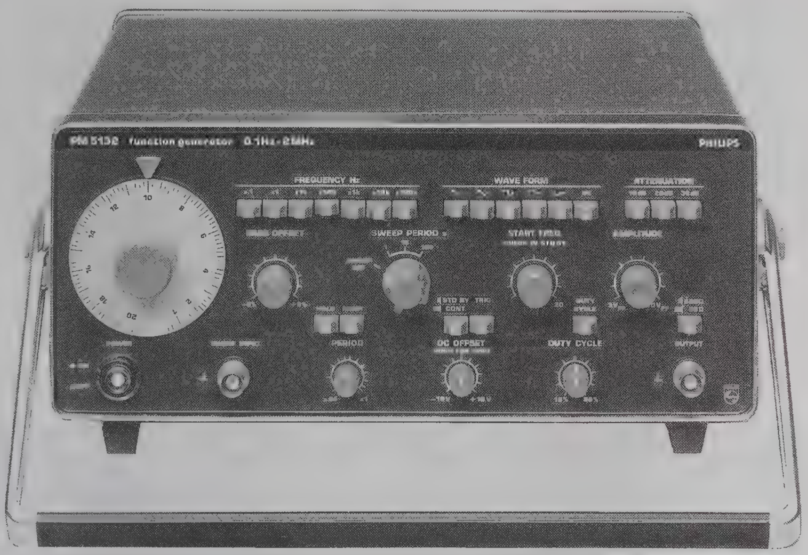
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

PM 5132



PM 5132

PM 5132 2 MHz Function Generator

- Sine, square, triangular waveforms, positive- and negative-going pulses plus dc
- 0.1 Hz to 2 MHz in 7 overlapping sub-ranges
- Output: 30V p-p (sine, triangle, square); (15V p-p for pulses)
- Stepped and variable attenuation over 80 dB range
- Variable dc-offset
- Internal and external linear sweep facility
- Variable duty cycle

The PM 5132 is for use in educational applications as well as the laboratory. Its output waveforms (sine, triangle, and square, plus dc) also include both positive- and negative-going pulses, with output voltage of 30V p-p for all waveforms, and 15V p-p for pulses. Duty cycle for all waveforms is variable between 10% and 90%. In addition, output impedance is switchable with a choice of 50Ω or 600Ω.

The frequency range of 0.1 Hz to 2 MHz is adjustable through 7 overlapping sub-ranges and the vernier "FREQ OFFSET" control allows frequency settings of ± 5% of the dial setting.

Sweep facilities are varied and include:

- Choice of linear single or continuous sweep
- Adjustable start frequency in the selected sub-range, independent of stop frequency
- Maximum linear sweep range of 2 decades
- Sweep period setting between 50 ms and 100s
- Control functions with HOLD or RESET by pushbutton
- Electronic triggering

A pen lift output is provided. The instrument is short-circuit proof.

Good ergonomic design makes the operation simple while the instrument occupies minimal bench space.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 0.1 Hz to 2 MHz
Setting Error: ±2% to ±0.2% of max sub-range frequencies
Vernier Frequency Adjustment: -5% to +5% of frequency setting
Temperature Coefficient: <0.15%/K
Short Term Drift: <0.1%, f <200 kHz (<15 min)
Long Term Drift: <0.25%, f <200 kHz (<7h)
Duty Cycle: 50% fixed; 10% to 90% continuously adjustable

Waveforms

Sine wave
Square wave
Triangular wave
Positive pulse
Negative pulse
} with or without dc offset
DC voltage without ac

Outputs

AC Voltage
Max Open Circuit Voltage: 30V p-p (15V p-p for pulse)
Attenuation: 10, 20, 30 dB calibrated steps selectable in any combination plus 20 dB continuously adjustable
Impedance: 50Ω or 600Ω selectable
Short-circuit proof: Yes

DC Voltage
Offset Voltage: -10 to +10V (open circuit)

Sine Wave

Total Harmonic Distortion: <0.5% (0.1 Hz to 20 kHz); <1.0% (20 kHz to 200 kHz); <3.0% (200 kHz to 2 MHz)
Frequency Response of Amplitude: <0.1 dB (0.1 Hz to 20 kHz); <0.3 dB (0.1 Hz to 1 MHz); <1.0 dB (0.1 Hz to 2 MHz)

Triangle Wave

Linearity: <99% (0.1 Hz to 100 kHz)

Square Wave

Rise and Fall Time: <75 ns
Overshoot and Ringing: <2%

TTL

Duty Cycle: As main output
Fan Out: 20 TTL inputs

Sweep Output

Internal Sweep
Characteristics: Linear
Max Sweep Range: 2 decades
Mode: Single or continuous
Period Time: 50 ms to 100s; continuously adjustable in 3 sub-ranges
Control Functions: HOLD, RESET, TRIG (manually and electronically)
Frequency Control Voltage: 0V to 5V; (depending on start- and stop-frequency)

External Sweep
Input: SWEEP TRIG
Characteristic: Linear
Max Sweep Range: 2 decades
Input Resistance: 47 kΩ
Max Sweep Frequency: 15 kHz approx
Sensitivity: 5V for maximum range

PM 5132

General Specifications

Power Requirements

Voltage: 110V, 128V, 220V, 238V ±10%
Power Consumption: 25W
Frequency: 50 Hz to 100 Hz

Operating Conditions

Reference Value: +23°C +1°C
Nominal Operating Range: +5°C to +40°C
Storage and Transportation: -40°C to +70°C

Mechanical Data

Size: 310 mm W x 140 mm H x 330 mm L (12.2 in W x 5.5 in H x 13 in L)
Weight: 5 kg (11 lb)

Ordering Information

Model

PM 5132M Function Generator

Included with Instrument
One-year product warranty, Instruction manual.

Accessories (Also see Section 19)
PM 9075 Cable BNC-BNC
PM 9560 19-in Rack Mount Adapter

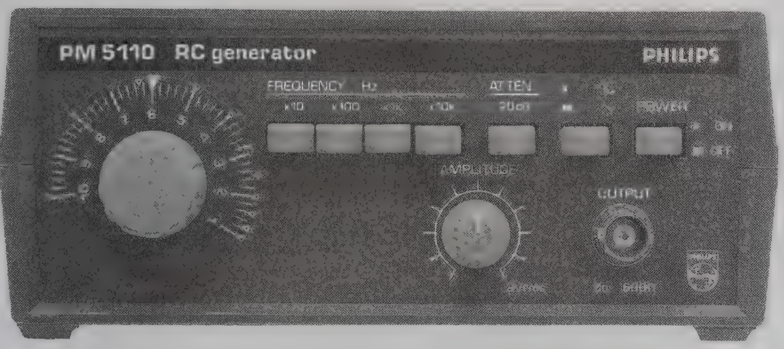
Manual
PM 5132 Instruction*
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

PM 5110



PM 5110

PM 5110 Low Distortion LF Generator

- 0.02% distortion
- Compact dimensions and light weight
- Frequency range 10 Hz to 100 kHz
- Sine and square wave signals
- 6V p-p output and separate TTL output
- Attention switchable between fixed (20 dB) and variable (40 dB)

The PM 5110 meets the need for a compact, economical low frequency signal generator with an outstanding low distortion down to only 0.02%. It provides a choice of sine wave and square wave outputs from a front-panel BNC connector, and also includes an additional rear-panel TTL output, making it a versatile instrument for use in education and training. Further, its very low distortion rating makes it an ideal high-purity signal source for laboratory and service use, particularly in audio-related applications.

Signal amplitude is a maximum of 6V p-p for sine waves, and 4V p-p for square waves. Attenuation is continuouly variable from 0 dB to 40 dB at a constant 600Ω impedance; alternatively, a fixed attenuation of 20 dB can be selected to simulate outputs from recorders and other equipment.

Operation is simple, thanks to the PM 5110's functional layout. A single dial adjusts frequency, with range multiplier pushbuttons giving an accuracy of better than 4%. Also, the generator weighs only 1 kg, and is very compact in size.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 10 Hz to 100 kHz (4 subranges, selectable by pushbuttons)
Indication: Dial (1 to 10) LED marker
Setting Error: <4% ±1 Hz
Temperature Coefficient: <0.05%/K (1 kHz)
Long-Term Drift: (<7h) $<1.5 \times 10^{-3}$ (1 kHz)
Duty Cycle: 50% fixed

Waveforms

Sine wave
Square wave

Output

Attenuation: 20 dB (±0.2 dB) calibrated step plus 40 dB continuously adjustable
Impedance: 600Ω
Short-Circuit Proof: Yes

Sine Wave

Low Distortion Mode: Total harmonic distortion 0.02% at 1 kHz; 0.03% (300 Hz to 20 kHz)
Fast Settling Mode: Total harmonic distortion 0.5% (300 Hz to 20 kHz); 0.7% (10 Hz to 100 kHz)
Max Open Circuit Voltage: 2V rms
Frequency Response of Amplitude: <2% referred to 1 kHz

Square Wave

Max Open Circuit Voltage: 4V p-p
Rise and Fall Time: <0.5 µs
Sag: <1% (50 Hz)
Duty Cycle: 50%
Overshoot and Ripple: <1.5%

TTL

(fast setting mode only)
Amplitude, High Level: 4.5V ±0.7V
Amplitude, Low Level: <0.3V
Sag: <1%
Rise Time: <30 ns
Fall Time: <15 ns
Fan Out: 10 TTL inputs

General Specifications

Power Requirements

Voltage: 115V, 230V ±15%
Power Consumption: 6W
Frequency: 50/60 Hz ±5%

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C to +40°C
Limits of Storage and Transportation: -40°C to +70°C

Mechanical Specifications

Size: 155 mm W x 65 mm H x 180 mm L (6.1 in W x 2.6 in H x 7.1 in L)
Weight: 1.1 kg (2.4 lb)

Ordering Information

Model

PM 5110* Low Distortion LF Generator
**Available in European countries only*

Included with Instrument
Instruction manual and power cable.

Accessories
PM 9075 Cable BNC-BNC

Manual
PM 5110 Instruction*
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

PM 5109

PM 5109

PM 5109 Low Distortion LF Generator

- Symmetrical floating output
- Very low distortion of only 0.02%
- 10 Hz to 100 kHz frequency range
- Sine and square wave signals
- Output voltage: 30V p-p (asymmetrical), 10V p-p (symmetrical)
- Separate TTL and DIN loudspeaker output
- Output level indication

The PM 5109 is an RC oscillator offering a very low distortion, 0.02% at 1 kHz in the low distortion mode. It can also be used in a fast settling mode, useful for fast, routine work. These features, plus the facility to select asymmetrical or FLOATING SYMMETRICAL OUTPUT, make it ideal for telecommunication applications as well as for education R&D, manufacturing and audio equipment servicing.

Both output voltages can be attenuated by a continuous control; the asymmetrical output can also be attenuated in steps of 10 dB down to 60 dB.

Both sine wave or square wave signals can be selected at frequencies from 10 Hz to 100 kHz; output impedance is switchable for either 600Ω or 50Ω in the asymmetrical mode and 600Ω or LOW Z in the symmetrical mode.

A DIN loudspeaker connection is provided, with an impedance similar to the symmetrical low impedance output. This allows direct testing of loudspeakers, regardless of their impedance. A special TTL output for direct connection to TTL circuitry or for synchronization purposes, is also provided.

The open circuit output voltage is monitored by a meter on the front panel and the output range in use is indicated by the appropriate LED.

Specifications

Frequency and Characteristics

Nominal Range: 10 Hz to 100 kHz (4 subranges, selectable by pushbuttons)
Indication: Dial (1 to 10)
Setting Error: <±5% ±1 Hz
Temperature Coefficient: <0.05%/K
Long Term Drift (<7h): <1.5 x 10^{-3}
Short Term Drift (<15 min): <0.5 x 10^{-3}
Duty Cycle: 50% fixed

Waveforms

Sine wave
Square wave (output B only)

Output (Separate A and B output selectable with pushbuttons)

A. Symmetrical Output: (4x4 mm banana connector on front panel)

$$\left.\begin{array}{l}\text{a. } 2 \times 300\Omega \\ \text{b. } 300\Omega + 300\Omega \\ \text{c. } 2 \times \text{low Z} \\ \text{d. low Z + low Z}\end{array}\right\}\text{ not grounded}$$

B. Asymmetrical Output: (BNC connector at front panel)
a. 600Ω
b. 50Ω
Loudspeaker Output: (DIN connector at rear panel) only active when output Ad is selected
TTL Output: (BNC connector at rear panel)
Open Circuit Output Voltage: (RMS) 0.03V to 3.16V (output A); 0.1V to 10V (output B)
Indication: Meter (7 ranges indicated by LED)
Attenuation: 10, 20, 30 dB calibrated steps selectable in any combination (output B only) plus 30 dB continuously adjustable

Sine Wave

Total Harmonic Distortion (for output Aa, Ab, and B)
Low Distortion Mode: <0.7% (10 Hz to 100 kHz); <0.03% (300 Hz to 20 kHz)
Fast Settling Mode: <1.5% (10 Hz to 100 kHz); <0.5% (100 Hz to 100 kHz)

Total Harmonic Distortion (for output Ac & Ad)
Low Distortion Mode: <0.7% (open circuit 20 Hz to 100 kHz); <0.03% (open circuit 300 Hz to 20 kHz): <0.15% (4Ω load, 20 Hz to 100 kHz)
Fast Settling Mode: 0.5% (4Ω load, 100 Hz to 100 kHz)
Frequency Response of Amplitude: ±0.2 dB (1000 Hz, outputs A & B, open circuit); ±0.5 dB (10 Hz to 10 kHz, outs Ac & Ad, 4Ω load)

Square Wave

Rise and Fall Time: <0.5 µs
Overshoot and Ringing: <20 Hz); <1% (>50 Hz)

TTL

Level: High >2.4V; low <0.8V
Duty Cycle: 50%
Fan Out: 20 TTL inputs

Power Requirements

Line Voltages: 110V, 128V, 220V, 238V ±10%
Frequency: 50 Hz to 100 Hz
Power Consumption: 17W

Mechanical Data

Size: 310 mm W x 140 mm H x 330 mm L (12.2 in W x 5.5 in H x 13 in L)
Weight: 6.5 kg (14.3 lb)

Ordering Information

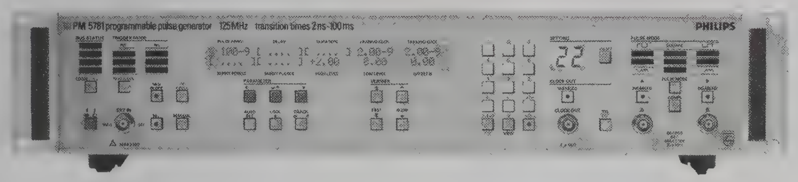
Model

PM 5109* RC Generator with Symmetrical Floating Output

** Available in European countries only*

Included with Instrument
Instruction manual, line cord, Certificate of Calibration practices.

Accessories
PM 9075 Coaxial Cable BNC-BNC
PM 9580 19-inch Rack Mount Adapter


PM 5781 programmable pulse generator 125MHz transition times 2ns-100ms
PHILIPS

PM 5781

PM 5781 125 MHz Programmable Pulse Generator

- Wide 0.25 mHz to 125 MHz frequency range
- 2 ns to 100 ms rise and fall times
- 0.2V to 10V amplitude into 50Ω
- Dual pulse outputs
- Preset burst with external or internal burst generator
- 2-line x 40-character LCD display shows all 10 pulse parameters simultaneously
- Autoset key allows instant correction of erroneous setting
- High performance GPIB/IEEE-488 interface
- Internal calibration option

The PM 5781 Programmable Pulse Generator offers an unmatched combination of performance, precision and programmability - together with simple, logical operation through built-in microcomputer control.

The PM 5781 has been designed primarily for use in automatic test systems in GPIB/IEEE-488* environments. This advanced pulse generator offers 100% programmability of all functions and parameters, together with a wide range of facilities to support the work of the programmer.

In addition to its sophisticated system programmability, the PM 5781 is also a powerful and versatile benchtop instrument for use in manually operated, semi-automatic applications. A full- information display and clear, simple front-panel operation make it easy to precisely set-up the required pulse parameters.

The high speed, wide amplitude range and exceptional versatility of the PM 5781 enable you to handle virtually any analog and digital circuit testing requirements. Fast digital circuitry such as TTL, MOS or ECL is easily handled, and a wide choice of trigger and gate functions make the set-up of special test signals easier than ever before.

High Performance Pulses

The PM 5781 offers high-speed, high- performance pulses at repetition rates up to 125 MHz and as low as 0.25 mHz. This single generator can therefore cover a wide variety of application requirements.

The PM 5781's fast output pulses have rise- and fall times which are independently and continuously variable from 2 ns to 100 ms (10% to 90% of amplitude). The 20% to 80% transition times, as specified for ECL circuits, range from as low as 1.4 ns.

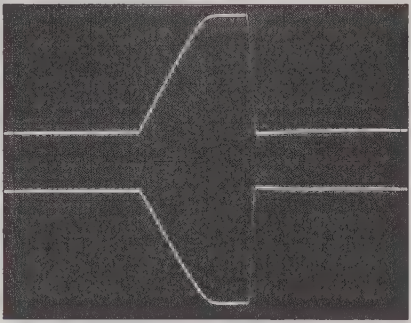
Output amplitudes (into 50Ω) are variable between 0.2V and 10V, within the -10V to +10V window. Pulse levels are directly defined by setting the high- and low-level values.

Dual outputs provide simultaneous positive- and negative-going pulses. Both outputs offer the same high-performance pulses. An additional offset facility on the B channel further enhances the versatility of the dual outputs. This offset voltage makes it possible to program bipolar pulses as well as complementary positive and negative pulses for digital applications. Limits on outputs may also be programmed.

Versatile Functionality

The PM 5781 gives you a wide range of versatile functions to simplify operation and enhance precision. A complete range of trigger and pulse mode facilities make it easy to get exactly the pulses you need:

Continuous pulses: generated by the internal clock generator or triggered by an external clock signal.

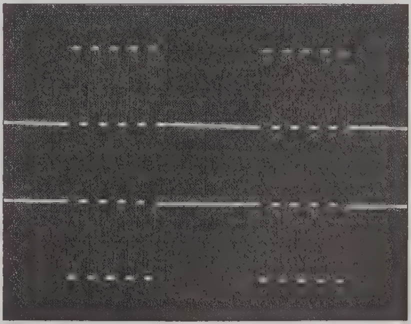


Pulse shape of dual outputs.

Single shot pulses: can be generated, triggered by an external trigger signal, manually or via the IEEE-488 bus.

Gated pulses: produce bursts of pulses generated by the internal clock, gated by an external gate signal. Burst frequency and duration are defined by the external gate signal.

Preset burst: generates bursts with a pulse frequency and duration defined by the PM 5781. The number of pulses in each burst is selectable from 1 to 9999. The burst repetition period can be externally triggered, or can be produced by the PM 5781's internal burst-period generator. This unique feature eliminates the need for an external generator, saving cost, rack-space and extra programming effort.



Pulse burst generated in internal burst mode.

External duration: the generator functions as a pulse- shaper and/or booster for external signals. These define the frequency and pulse duration, while the high and low levels, rise and fall times and normal/complementary mode selection are defined by the pulse generator settings.

Automatic 'track' mode: maintains the programmed relationships between specified pulse parameters, for fast, simple setting-up. For example, a preset duty cycle value is easily maintained by making the pulse duration track the period. Or the pulse high and low levels can be tracked to get a constant pulse amplitude.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 5781

Advanced IEEE-488 Bus Facilities

The PM 5781 has been designed primarily for automatic test system applications, and offers advanced facilities for operation via the IEEE-488 bus. All functions and parameter values are 100% programmable.

To reduce your system development time, the PM 5781 complies fully with the new IEEE standard 488.2-1987 (Standard Codes, Formats, Protocols and Common Commands). So test programs can be written quickly and efficiently, even when using the PM 5781 for the first time.

A wide range of features facilitate programming and speed-up operation via the bus, for example:

LRN? and BINPROG?: helps you write instrument programming codes, even without programming experience. The pulse generator transmits the full string of programming commands corresponding to the current manual setting.

CODES? and SYNTAX?: programming help functions. After transmitting one of these queries, the pulse generator returns headers for all codes, or gives the syntax for a requested command. These functions make programming extremely easy, even without the manual or programming card.

Debug mode: instead of showing the numeric pulse parameter values, the display shows the programming string received via the bus. So operating problems, bus control failures and software incompatibilities are easily detected.

Speed: once your program is debugged, the instrument's operating speed can be improved further by disabling a number of functions such as error checking, local displays etc. The bus commands and the bus interface have been optimized for very fast bus operation.

49 complete instrument settings: can be saved in non- volatile memory and recalled by a short and simple command. The bus transaction time for this command is only a few milliseconds.

Internal Calibration Option

The incorporation of time and voltage measurement circuitry into the PM 5781 provides the instrument with internal calibration facilities which enhance its effective accuracy and improve reliability. Other benefits of the on-board internal calibration facilities include extended external calibration intervals and reduced downtime and cost of ownership.

The internal calibration option consists of an additional circuit board, containing timer/counter and pulse voltage measurement facilities. This internal calibration unit functions as an independent calibration and adjustment instrument referenced to an internal crystal oscillator timebase and a high-stability voltage reference. External access to these internal references assists in making the internal calibration process fully traceable to external standards.

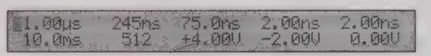
The calibration process can be controlled manually from the PM 5781's front panel, or automatically via the IEEE-488 interface. In either case, there is no need to open the case of the instrument, and calibration can even be carried out in-situ at your system's operating temperature.

Since internal calibration takes only a few minutes, the generator can, if necessary, be calibrated at short intervals. The internal calibration facility includes: performance test, adjustment of calibration constants and print-out of the calibration measurements via an IEEE-488 controller. The use of a password prevents unauthorized changes of calibration constants.

Full Information about Status and Settings

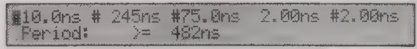
The PM 5781 has a 2-line x 40-character alphanumeric display that gives at-a-glance information about all settings, parameter values and status. This complete information display makes benchtop use quick and easy, and provides valuable information for systems programmers, reducing development costs and time.

Displayed parameter values. Values of all 10 pulse parameters are displayed simultaneously, giving a complete overview of the current setting and making instrument set-up fast and simple.



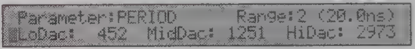
```
▒1.00us   245ns  75.0ns   2.00ns   2.00ns
 10.0ns     512  +4.00V  -2.00V    0.00V
```

Efficient error handling. Any illegal parameter values or conflicting combinations are automatically detected and error messages displayed. Correction is simple, using the VERNIER, AUTOSET or RESET functions.



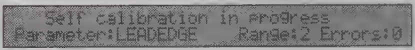
```
▒10.0ns # 245ns #75.0ns  2.00ns #2.00ns
 Period:     >=  482ns
```

Calibration and diagnosis for confidence in operation. Built-in procedures enable easy calibration and diagnosis using external instruments. Menu- and cursor- driven operation allows easy step-through of performance tests and calibration routines.



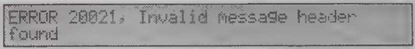
```
 Parameter:PERIOD        Range:2 (20.0ns)
▒LoDac:  452  MidDac: 1251  HiDac: 2973
```

Internal self-calibration. The optional enhanced accuracy version incorporates built-in hardware and firmware for internal calibration. These facilities ensure constant confidence in performance and compliance with specifications.



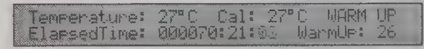
```
   Self calibration in progress
 Parameter:LEADEDGE    Range:2 Errors:0
```

Built-in programming support. Display of GPIB error messages makes programming simple, even without the manual or reference card. On-line help information can be called-up instantly at any time from the controller, using 'Help?', 'Codes?' and 'Syntax?' programming help functions.



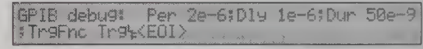
```
ERROR 20021, Invalid message header
found
```

Debug mode displays programming strings. In Debug mode, the PM 5781 displays the programming string as actually received via the bus. So operating problems caused by hardware failure or software incompatibility are easily detected.



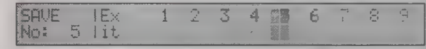
```
 Temperature: 27°C  Cal: 27°C  WARM UP
 ElapsedTime: 000070:21:03  WarmUp: 26
```

Information display mode. Instrument status is always clearly visible at-a-glance, for example with indications like warming-up, calibration status, calibration temperature, actual temperature and elapsed time.



```
GPIB debug:  Per 2e-6;Dly 1e-6;Dur 50e-9
;TrgFnc Trg;<EOI>
```

Saved settings display. 49 user-defined instrument settings can be saved in non-volatile memory for instant recall at any time. The 'Setting' display shows the selected memory position. Recall sequences can be defined, and 'Next' and 'Previous' commands allow manual stepping-through the stored settings.



```
SAVE    |Ex     1   2   3   4  ▒5   6   7   8   9
No:   5 |it                    ▒
```

Specifications

Technical Specifications

Specifications apply with all outputs terminated with 50Ω load resistance.

Table 1. Inaccuracy and repeatability error specifications:

Temperature Range	20°C - 30°C 1)	0°- 50°C	After calibration 2) Typical values	Repeatability Error Typical values
Period 3):	±3% ±0.5 ns	±5% ±0.5 ns	±1% ±0.5 ns	±0.5%
Period 4):	±0.1%	±0.1%	±0.1%	±0.1%
Delay:	±3% ±1 ns	±5%±1 ns	±1% ±1 ns	±0.5%
Duration:	±3% ±1 ns	±5% ±1 ns	±1% ±1 ns	±0.5%
Transition Times:	±5% ±1 ns	±8% ±1 ns	±3% ±1 ns	±1%
Voltage Levels:	±1% of level ±2.5% of ampl. ±40 mV	±1% of level ±3% of ampl. ±60 mV	±1% of level ±2% of ampl. ± 20 mV	±0.5% of level ±0.5% of ampl. ±20 mV
Burst Repetition Period:	±20 ppm	±20 ppm	±20 ppm	±20 ppm

1) Manual calibration is possible for another operating temperature range, through a menu-and-cursor driven procedure, accessible via the front panel. The 20 °C to 30 °C specifications then apply within 5 °C from the actual calibration temperature.

2) The enhanced accuracy version of PM 5781 features built-in capabilities for internal calibration. The specified inaccuracies then apply for 24 hrs within 5 °C from the actual calibration temperature.

3) After the 5th pulse in each burst in Gate and Burst Modes.

4) In Internal Trigger Mode with Period Control on.

Time Parameters

Specified at 50% of pulse amplitude at minimum transition times.

Pulse Repetition Period

Range: 8 ns to 10s *
Programming Resolution:
Internal trigger mode; 4 digits
Gate and burst modes; 3 digits
Jitter rms: 0.1% + 50 ps for period times < 1 µs; 0.03% for period times ≥1 µs

** In internal burst mode, with only 1 pulse per burst, the period range is extended up to 4000s*

Pulse Delay

Range: 8 ns to 1s
Programming Resolution: 3 digits
Jitter rms: 0.1% + 50 ps

Pulse Duration

Range: 4 ns to 1s
Programming Resolution: 3 digits
Jitter rms: 0.1% + 50 ps
Duty Factor: Up to 50% in normal mode. Approaching 100% in complementary mode.

Constant Duty Factor

Repetition Period and Pulse Duration Tracked
Range: 0 % to 50% in normal mode, 50% to 100% in complementary mode

Preset Burst

Range: 1 to 9999 pulses in each burst
Internal Burst Repetition Period: 1 µs to 4000s
Programming Resolution: 4 digits, min 1 µs
External Burst Repetition Period: >250 ns

Transition Times

(Between 10% and 90% of amplitude)
Range: 2 ns to 100 ms
Minimum transition time, between 20% and 80% of amplitude, is 1.4 ns.
Leading and trailing edge transition times are independently programmable within each of the following ranges:
2 ns to 20 ns;
10 ns to 200 ns;
100 ns to 2 µs;
1 µs to 20 µs;
10 µs to 200 µs;
100 µs to 2 ms;
1 ms to 20 ms;
10 ms to 100 ms
Programming Resolution: 3 digits
Linearity: ≤10% for transitions < 20 ns, ≤5% for transitions ≥20 ns

System Delays

Main Pulse Outputs
Fixed trigger input to main output delays
External Trigger Mode: Approx. 35 ns
External Gate Mode: Approx. 45 ns
External Burst Mode: Approx. 60 ns
External Duration Mode: Approx. 35 ns
Applies in double pulse and square wave modes. Add programmed pulse delay in single pulse mode.
Clock Output
Pulse Advance: Approx. 8 ns ahead of main outputs in double pulse and square wave modes. Approx. 8 ns plus programmed pulse delay ahead of main outputs in single pulse mode.

Outputs

Main Pulse Outputs

Outputs: 2 channels, A (normal) and B (complementary)
Pulse Modes: Single pulse, double pulse and square wave
Output Mode: Normal/complementary; to make A complementary and B normal
High Level Range: -9.80V to +10.0V
Low Level Range: -10.0V to +9.80V
Programming Resolution: 10 mV
Pulse Amplitude: 0.2V to 10V, being the difference between the high and low levels
Offset Channel B: within ±10V
Preshoot, Overshoot, Ringing: ±5% of pulse amplitude ±10 mV
Source Impedance: 50Ω, reflection coefficient < 0.1
Output Disable: Output signal connect/disconnect
Level Limit: High and low levels can be limited to pre-programmed values
Output Protection: Against short and open circuit

Clock Output

Pulse Levels into 50Ω: TTL; low 0V, high 2.5V (doubles when driving into open circuit), ECL; high -0.8V, low -1.7V
Transition Time: 1.5 ns typically
Source Impedance: 50Ω
Output Protection: Against short and open circuit
Output Disable: Output signal connect/disconnect

Burst Sync Output

Approx 0.4V pulse amplitude into 50Ω from 50Ω source during the pulse burst duration
Levels: high -0.4V, low -0.8V

Input

External Input

Frequency Range: DC to 125 MHz
Minimum Pulse Duration: 4 ns
Sensitivity: 500 mV p-p
Dynamic Input Voltage Range: 10 Vp-p within ±10V
Trigger Level Range: -5.00V to +5.00V
Programming Resolution: 10 mV
Trigger Slope: Positive or negative
Input Impedance: 1 MΩ//45 pF or 50Ω
Max Input Voltage Without Damage: 10V rms, 50V rms at 1 MΩ and at <10 MHz

Trigger Modes

Internal Triggering: Continuously repetitive waveform is generated
Internal Gate: Internal burst generator enables the period generator synchronously, burst duty factor 50%

PM 5781

Internal Burst: Internal burst generator enables the period generator to provide a preprogrammed number of pulses (1 to 9999)
External Triggering: Each input pulse generates a single output pulse
External Gate: External signal enables internal period generator synchronously
External Burst: Each input pulse generates a pre-programmed number of pulses (1 to 9999)
External Duration: External signal generates an output signal with same duration and repetition rate and selectable transition times and output levels
Manual: Simulates an external input signal

Features

Front Panel Displays

Alphanumeric Display: 2-line x 40- character alphanumeric LCD display with backlighting. The display shows all 10 pulse parameters simultaneously. The display is also used for various function selection and error massages.
Bus Status Display: An LED display shows REMOTE, LLO, ADDR (listen/talk) and SRQ
Trigger Mode Display: An LED display shows trigger mode
Setting Number Display: An LCD display shows setting number
Pulse Mode Display: An LED display shows main pulse output mode

Non-Volatile Memory

Internal battery-backed RAM is used to save settings. Current setting is saved on power down
Power On: Last setting is activated when the power is switched on (output disabled)
Settings: 49 complete instrument settings can be saved and recalled
Macros: Up to 20 macros can be defined and saved

Error Handling

Error Detection: Erroneous settings are detected and error messages are displayed
Autoset: Erroneous settings are corrected with the AUTOSET key

Track

A change of one pulse parameter value can automatically cause other parameters to follow proportionally. E.g. tracking of pulse period and duration results in a pulse with constant duty factor

Lock

Unintentional changes of numerical parameter values can be prevented by the locking facility

Enhanced Accuracy Version PM 5781/02

The enhanced accuracy version includes circuitry that can measure pulse parameters. The internal frequency and voltage references which are part of this measuring system can be made accessible via the front panel to enable external traceability of the internal calibration function.
Parameters Measured: Period, delay, duration, leading and trailing edges, high and low levels and offset B
Time for Internal Calibration: Approx 3 min
Inaccuracy: See table 1

IEEE-488 Capabilities

All functions and parameters are programmable. The interface complies with the requirements of the IEEE-488.1 - 1987 and IEEE-488.2 - 1987 Standards
Interface Functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
Address Range: 0 to 30, set via front panel
Addressing Time: 17 µs
Times for bus transfer of settings:
Complete Parameter Set: 3 ms (binary format)
Single Command: 600 µs
Times to implement settings (ErrorCheck and DispMode Off):
Complete Parameter Set: 50 ms (binary format)
Single Command: 30 ms
***RCL:** 15 ms
Acknowledgment of complete execution is possible with *OPC? command or service request signal.
GET Time: 360 ns (DAV to H.W. line trigger)
GET with Addressing: 19 µs

General Specifications

Environmental Conditions

Meets environmental requirements of MIL-T-28800D Type III, Class 5 as follows:
Calibration Interval: 1 year recommended, 2 years for enhanced accuracy version /02
Warm-Up Time: 30 min to reach specified performance

Ambient Temperature
Operating: 0°C to +50°C.
Non-Operating: -20°C to +70°C
Altitude: <4600 m (15000 ft)
Humidity: <95% RH, 0°C to 30°C
Vibration: Operating; 15 min along each of the 3 major axis, 10 Hz to 150 Hz, 0.33 mm p-p amplitude and 2g max. acceleration
Shock: Operating; 3 shocks along each of the 3 major axis, half-sinewave, 6 ms duration and 40g acceleration pulses
Bench Handling: MIL-STD-810D method 516.3, procedure VI
Safety: CSA Bulletin 556B certified and Philips certification to comply with IEC 348, Class 1 requirements
Power: 100V, 120V, 220V and 240V ±10%, 48 Hz to 420 Hz, 200 VA

Mechanical Data

Size: 440 mm W x 89 mm H x 500 mm L (17.3 in W x 3.5 in H x 19.7 in L)
Weight: Net 12 kg (26.5 lbs), shipping 15.5 kg (33 lbs)

Ordering Information

Models

PM 5781/011 Pulse Generator with Front Panel Connectors
PM 5781/012 Pulse Generator with Rear Panel Connectors
PM 5781/021 Pulse Generator with Front Panel Connectors and Built-in Calibration Facility
PM 5781/022 Pulse Generator with Rear Panel Connectors and Built-in Calibration Facility

Included with Instrument
One-year product warranty, power cord, benchtop conversion kit, operator's manual, and IEEE-488 pocket guides (qty. 3).

Accessories (Also see Section 19)
PM 9613 Rack Mount Slide Kit
PM 9581 50Ω Feedthrough Termination; 3W
PM 9584 50Ω T-Piece (matched power splitter)
PM 9585 50Ω Feedthrough Termination; 1W
PM 9588 50Ω Coaxial Cable Set (5x1 ns, 4x2 ns, 3x3 ns, 3x10 ns)

Manual
PM 5781 Operator*
PM 5781 Pocket Guide*
PM 5781 Service
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

PM 5786

PM 5786B pulse generator 1Hz-125MHz
PHILIPS
PULSE PERIOD
PULSE DELAY
PULSE DURATION
TRANSITION TIME
NUMBER OF PULSES
TRIGG GATE BURST
EXT IN
LEVEL
CLOCK OUT
OUTPUT
BIPOLAR

PM 5786

PM 5786 125 MHz Pulse Generator

- 1 Hz to 125 MHz pulse frequencies
- 2 ns to 100 ms rise and fall times
- Time-setting error LED indicators
- 0.2V to 5V amplitude into 50Ω
- Dual outputs for simultaneous + and - pulses
- Full external control facilities
- LED indicator for correct trigger levels
- Presettable burst option

Top Performance, Top Economy and Assured Time-Settings

The PM 5786 has the speed and versatility to handle virtually any analog or digital circuit testing requirement. Fast digital circuitry such as TTL or ECL is easily handled, and the wide choice of external trigger and gate functions make the setting up of special test signals unbeatably easy.

The PM 5786 offers a whole-spectrum of transition times from which to choose. It allows such versatility as independent and continuous variable settings of rise and fall times all the way from 2 ns to 100 ms. The PM 5786 is well suited for high-speed general-purpose applications such as in research and development, where many different pulse response tests may need to be made.

Ease of Operation

The PM 5786 offers features to simplify operation. Like the unique system of front panel time-setting-error indicator LEDs to provide clear confirmation that all time settings are correct. This prevents erroneous pulses, caused by incorrectly set pulse duration or pulse delay times or rise and fall times with respect to pulse period.

Versatile Pulse Selection

Additional ease of use results from simple and versatile selection of the desired kind of output pulses: bipolar, positive or negative. Simultaneous positive and negative going pulses can be selected for linear applications, as well as complementary positive or negative pulses for digital applications.

High-Speed, High-Fidelity Pulses

A choice of bipolar outputs and high-quality 4-range output attenuator make the generator very suitable for all kinds of linear applications. Very clean pulses are ensured by the excellent back-matching impedance that absorbs over 90% of reflections from mismatched loads.

Burst Mode

The PM 5786 is also available with burst mode option (PM 5786B), that enables generation of bursts containing selectable numbers of pulses from 1 to 9999. Pre-selection of the required number of pulses is easily carried-out, using front panel digital switches. Bursts can be triggered either manually or remotely by a signal to the EXTernal INput on the front panel. The use of the presettable burst mode is particularly valuable, for testing memory circuits, shift registers, counters and other digital circuits.

Other functions which can be selected and carried out remotely through the external input include:

- Externally triggered pulses
- Externally gated pulses (gives synchronized bursts of pulses)
- Externally controlled pulse duration.

External control signals can be applied to define the start (and duration) of the various control options. Start/stop conditions can be adjusted with the EXT IN LEVEL control both to select ± trigger slope and -3V to +3V trigger level. An LED indicates correct triggering.

For ECL testing: the minimum transition time is 1.4 ns, corresponding to 20% to 80% of pulse amplitude.

External Triggering

External triggering enables the PM 5786 to operate synchronously with external clock signals. All other parameters, such as pulse duration, amplitude etc. are as set on the pulse generator. External trigger signals can vary from 0 to 125 MHz, or, in the double pulse mode, 0 to 62.5 MHz.

External Gating

The external gate mode provides external synchronous on/off control of the pulse generator. As long as the external gate signal is present, output pulses are available with the preset pulse parameters.

External Duration

This mode allows the generators to function as input signal conditioners. The external input signal defines frequency and pulse duration, while amplitude, dc offset, rise and fall times and normal/complementary mode selection are defined by the pulse generator settings.

Square Wave Mode

A 'square wave' mode provides pulses with a constant 0.5 duty factor. This facilitates a quick method of setting the required output repetition rate, without having to consider the other time parameters.

Specifications

Technical Specifications

Time Parameters

Pulse Repetition Period: 8 ns to 1s (1 Hz to 125 MHz)
Pulse Delay: 8 ns to 100 ms
Pulse Duration: 3.5 ns to 100 ms or fixed square wave
Jitter: <0.1% of setting ±50 ps

PM 5786

Main Output Pulse Characteristics

Outputs: 2 channels, A and B
Transition Times: At $Z_L = 50\Omega$, 2 ns to >100 ms, continuously variable, corresponding to 10% to 90% of pulse amplitude

Pulse Amplitude: 0.2V to 5V (at $Z_L = 50\Omega$), double amplitude at open output
DC Offset: -2.5V to +2.5V (at $Z_L = 50\Omega$), ±5V at open output
Max. Output Voltage: Pulse amplitude plus dc offset is ±6V at max. Maximum 10V open output voltage within the -6v to +6V range.
Waveform Aberrations: $Z_L = 50\Omega$, <5% ±10 mV, <10% for transition times <5 ns
Source Resistance: 50Ω ±5%
Source Impedance: 50Ω ±10%
Output Protection: Against short- or open-circuit and transients

Pulse Modes

- Single pulse (delayable)
- Double pulse
- Square wave: 50% ±1% (1 Hz to 1 MHz); 50% ±10% (1 MHz to 125 MHz)
- Normal or complementary switchable

Output Modes: Bipolar, positive, negative polarity

External Operating Modes

TRIGG: Ext. triggered pulse repetition: DC to 125 MHz or manual single shot
GATE: Synchronous gating. Ext. input signal starts and stops the generator
BURST: Internally generated burst with digital switch selection of number of pulses: 0 to 9999, started by ext. input signal or manual control
EXT DUR: External duration gives pulses with same duration and repetition rate as external input signal, all other pulse parameters are set via the generator

External Input

Range: DC to 125 MHz; min. pulse duration 3.5 ns
Operating Input Voltage Range: 0.5 to 15V p-p
Coupling: DC
Input Impedance: 1 MΩ//25 pF
Trigger Level: -3V to +3V
Trigger Slope: + and -
Trigger Indicator: Tri-state LED indicator for correct trigger level setting
Maximum Input Voltage Without Damage: 260V rms at ≤440 Hz, declining to 15V p-p at 125 MHz

Internal Clock Output

Main output pulse is delayable with respect to internal clock output, which can thus be used as pre-trigger
Amplitude: +2.5V into 50Ω
Output Impedance: 50Ω (typ)
Transition Time: Approximately 1 ns
Pulse Duration: Square wave, 50% ±1% (1 Hz to 1 MHz), 50% ±10% (1 to 125 MHz)
Output Protection: Against short- or open-circuit and transients

General Specifications

Power Requirements

Line: 100V, 120V, 220V and 240V ±10%; 120 VA, 50 to 60 Hz
Safety: According to IEC 348 and CSA 556B
Line Interference: Below VDE 0871 (B)

Environmental Data

Temperature
Rated Range of Use: 0°C to +50°C
Storage and Transport: -40°C to +70°C

Humidity
Operating: 10 to 90% RH, no condensation
Storage: 5 to 95% RH

Mechanical Data

Size: 300 mm W x 145 mm H x 470 mm L (11.8 in W x 5.7 in H x 18.5 in L)
Weight: 9.5 kg (21 lbs)

Ordering Information

Models

PM 5786/00 2 ns Pulse Generator; excluding preset burst unit
PM 5786B/00 2 ns Pulse Generator; including preset burst unit

Included with Instrument
One-year product warranty, line cord, operator and service manual, and Certificate of Calibration Practices.

Accessories (Also see Section 19)
PM 9581/01 50Ω Feedthrough Termination; 3W
PM 9584/02 50Ω T-piece matched power-splitter
PM 9585/01 50Ω Feedthrough Termination; 1W
PM 9588/01 50Ω Coaxial Cable Set (5 x 1 ns, 4 x 2 ns, 3 x 3 ns, 3 x 10 ns)

Manuals
PM 5786 Operator*
PM 5786B Service*
**No charge with purchase of unit*

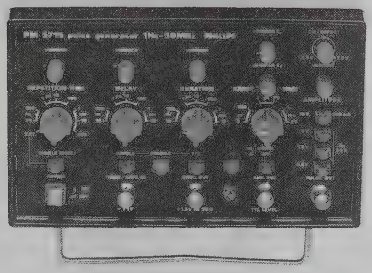
Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

PM 5712 & PM 5715

PM 5712



PM 5715

PM 5712 & PM 5715 50 MHz Pulse Generators

- Frequency range: 1 Hz to 50 MHz
- Rise/fall times: PM 5712, 4 ns fixed; PM 5715, 6 ns to 500 ms, variable
- Amplitude range: 0.2V to 10V
- DC offset: PM 5712, -5V to +2V; PM 5715, -2.5V to +2.5V
- Facilities for: manual and external triggering, gating, and pulse shaping
- Pulse modes: single/double, normal/inverted, positive/negative

Technical Specifications

Time Parameters

Pulse Repetition Time: 20 ns to 1s (1 Hz to 50 MHz)
Pulse Delay: 10 ns to 100 ms
Pulse Duration: 10 ns to 100 ms
Jitter: ≤0.1% of setting ±50 ps

Main Output Pulse Characteristics

Pulse Amplitude: 0.2V to 10V at $Z_L = 50\Omega$

Polarity
PM 5715: + or - switchable
PM 5712: + only, pulses within -5V to +10V possible, using dc offset and norm/inv

Transition Times
PM 5715: 6 ns to 500 ms
PM 5712: 4 ns fixed

DC Offset at $Z_L = 50\Omega$
PM 5715: -2.5V to +2.5V
PM 5712: -5V to +2V

Max Output Voltage: Pulse amplitude and dc offset max. +10V
Waveform Aberrations:<±5% of set amplitude
Source Impedance: Current source of 200 mA in 10V range, terminated with internal 50Ω in 5V and lower ranges

Pulse Modes
- Single pulse (delayable)
- Double pulse
- T/2, 50% duty cycle, 50 ±20% duty cycle in 20 ns and 100 ns repetition range

Logic Mode: Normal or inverted

Auxiliary Pulse Output Characteristics

Pulse Amplitude: TTL-compatible, +2.5V into 50Ω or +4.5V open circuit
Source Impedance: 50Ω
Pulse Modes: Single pulse, double pulse, not T/2. The pulse occurs approx. 12 ns ahead of main pulse.
Output Protection: Against short or open circuit

Sync. Output

Function: Pre-trigger output, main output pulse is delayable with respect to sync. output
Amplitude: +1.5V at $Z_L = 50\Omega$, +3V open circuit
Output Impedance: 50Ω
Pulse Duration: Square wave
Output Protection: Against short or open circuit

External Operating Modes

TRIG: Ext. triggered pulses, range: DC to 50 MHz or manual single shot
GATE: Synchronous gating, external signal starts and stops the generator
EXT DUR: External duration gives pulses with same duration and repetition rate as external input signal, all other pulse parameters are set via the generator

External Input

Function: For external trigger, gate and duration
Range: DC to 50 MHz
Coupling: DC
Input Impedance: Approx 220Ω at <1.5V, approx 800Ω at >1.5V
Trigger Level: ≥+1V
Trigger Slope: Positive
Max. Input Voltage Without Damage: ±12V

General Specifications

Power Requirements

Line: 85V to 110V, 99V to 127V; 170V to 220V, 198V to 255V
Line Frequency: 50 Hz to 400 Hz
Power Consumption: 70 VA

Environmental Data

Temperature Range
Operating: 0°C to 50°C
Storage: -40°C to 70°C

Mechanical Data

Size: 210 mm W x 130 mm H x 275 mm L (8.3 in W x 5 in H x 10.8 in L)
Weight: 4 kg (8.8 lb)

Ordering Information

Models

PM 5712/08 Pulse Generator
PM 5715/11 Pulse Generator

Included with Instrument
One-year product warranty, line cord, and operator manual.

Accessories (Also see Section 19)
PM 9581/01 50Ω Feedthrough Termination (3W)
PM 9584/02 50Ω T-Piece matched power splitter
PM 9585/01 50Ω Feedthrough Termination (1W)
PM 9588/01 50Ω Coaxial Cable Set

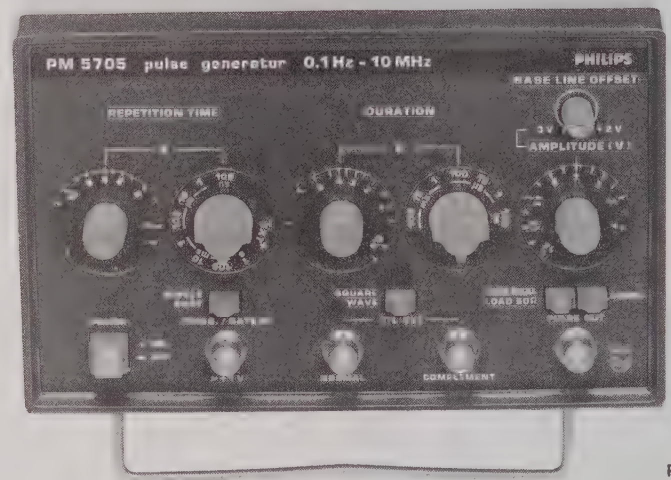
Manuals
PM 5712 Service
PM 5712-15 Operator*
PM 5715 Service
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

PM 5705



PM 5705

PM 5705 10 MHz: 15V Output Pulse Generator

- 0.1 Hz to 10 MHz frequency range
- TTL–Compatible outputs, both normal and complimentary
- 1.0V to 15V into 50Ω for TTL, HNIL and MOS applications
- Baseline offset from 0 up to +2V
- Resettable, engraved scales
- External triggering on positive or negative slope; gating and single shot facilities

Time Parameters

Repetition Rate: 0.1 Hz to 10 MHz variable in 8 ranges with continuous control of the ranges. Jitter less than 0.1%.
Duration: 50 ns to 500 ms variable in 7 ranges with continuous control within the ranges. Jitter less than 0.1%.
Duty Factor: Approaching 100% using complementary pulse. More than 50% in normal pulse mode.
Delay: In square wave mode the positive edge of the TTL complementary is delayed from the complementary main pulse. The delay time is the set duration subtracted from half the repetition time.

15V Pulse Output

Amplitude: Continuously variable from +1V to +15V into 50Ω. Max current 300 mA.
Source impedance: Voltage source with about 300Ω or 50Ω termination
Polarity: Positive
Modes of Operation: Normal or complementary
Baseline Offset: Continuously variable from 0 to +2V max. offset current 80 mA. Only the baseline is shifted.
Ramp Time: ≤10 ns at 5V and lower amplitudes with 50Ω internal or external termination. Typically 10 ns at 10V and 15 ns at 15V. (Typical rise time 6 ns).
Waveform Aberration: Less than ±5% between 3V and 15V into 50Ω and base line offset 0V.
Protection: Short and open circuit safe.

TTL Pulse Outputs

Amplitude: TTL level. Fan out 30 gates. About 4.5V open circuit.
Polarity: Positive
Modes of Operation: Normal & complementary
Ramp Time: About 10 ns
Waveform Aberration: Less than 5% into 50Ω
Protection: Short and open circuit safe
Pulse Output: 50Ω TTL linedriver with filter for waveform correction, designed for 50Ω load

Triggering and Gating

External Triggering and Gating
Level: ≥+1V to trigger or gate the generator. Max ±20V.
Slope Selection: Positive or negative slope
Frequency: 0 to10 MHz
Input Impedance: Approx. 1 kΩ Gating signal turns the generator 'off'. First pulse coincides with trailing edge of gating pulse.
Pulse Shaping: In square wave mode with repetition time set to external the frequency and duration of the output pulse'are determined by the trigger pulses
Single Shot: Single shot facility by means of push-button. In square wave mode the TTL pulse duration is determined by the time the push button single shot is depressed.
Manual Gating: Depressing the single shot push-button inhibits pulses when the generator is internally triggered

General Specifications

Temperature Range: 0 to 40°C

Power Requirements

Line Voltage: 90V to 127V, 180V to 253V
Frequency: 50 Hz to 400 Hz
Consumption: 40 VA

Mechanical Data

Size: 210 mm W x 130 mm H x 275 mm L (8.3 in W x 5 in H x 10.8 in L)
Weight: 3.5 kg (7.7 lb)

Ordering Information

Model

PM 5705/04* Pulse Generator
**Available in European countries only*

Included with Instrument
One-year product warranty, line cable, and instruction manual.

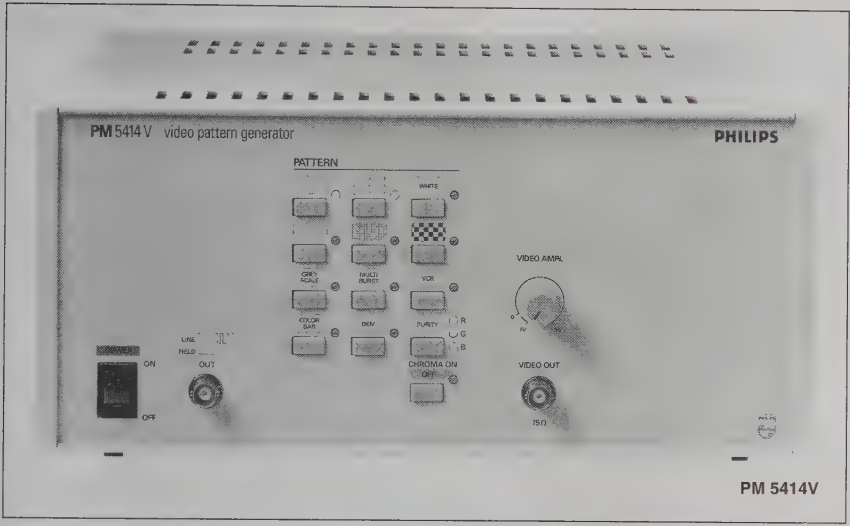
Accessories (Also see Section 19)
PM 9581/01 50Ω Termination
PM 9584/02 50Ω T-piece (matched power splitter)
PM 9585/01 50Ω Feedthrough Termination (1W)
PM 9588/01 Coaxial Cable Set (5 x 1 ns, 4 x 2 ns, 3 x 3 ns, 3 x 10 ns)

Manual
PM 5705 Instruction*
**No charge with purchase of unit*

Customer Support Services

Also see Section 20.

PM 5414V



PM 5414V

PM 5414V Color Pattern Generators

- Economic video monitor testing
- Over 70 color and monochrome patterns and combinations
- Simple to operate
- Special video version
- PAL and NTSC in one instrument

For video monitors trouble-shooting, the PM 5414V has every function you need at a very economic cost. The PM 5414V meets the specific requirements of the fast-growing video equipment market, including computer and closed circuit TV monitors.

The PM 5414V offers a choice of over 70 color and monochrome patterns and combinations, together with simple operation. Just connect the video monitor to be tested and key-in the required test pattern.

The selected settings are clearly indicated by LEDs next to the push buttons. Setting-up couldn't be quicker or more convenient, giving you exactly the test pattern you want, in only a few seconds.

PM 5414V for Monitor Testing

The economical PM 5414 V is the ideal solution for service shops handling large volumes of computer or CCTV monitors.

A front-panel CVBS output is standard, and an additional rear-panel Y/C + RGB output is available as a factory-fitted option. The RGB output includes SYNC and sub-carrier signals, to meet the specific requirements of color monitors and other video equipment. Separate Y/C is great for testing S-VHS recorders.

The PM 5414V is suited for PAL B, D, G, H and I and NTSC M standards.

Every Pattern You Need - at the Touch of a Button

Twelve push buttons make the selection of eighteen different test patterns possible. These patterns can be used for checking and aligning the monochrome and chrominance sections of video monitors.

Patterns and uses include:

- **Circle** - for linearity and geometry
- **Center cross/Border lines** - centering and pin-cushion correction
- **White** - 'White D', purity and beam current adjustment
- **Dot pattern** - static convergence
- **Cross hatch/Center indication** - dynamic and corner convergence, centering
- **Checkerboard pattern** - useful for basic alignments
- **Grey scale** (8 step) - video amplifier linearity
- **Multiburst** (8 bars of definition lines) - video bandwidth and resolution
- **VCR** - specially designed for checking bandwidth, linearity, sensitivity and AGC of chroma amplifiers in VCRs
- **Color bar** - overall color performance checks
- **DEM pattern** - color demodulator and sub-carrier frequency checks
- **Purity** (3 primary colors and combinations) - purity checks

Specifications

Technical Specifications

All specifications are valid for temperature range from +5°C to +50°C

Video

Video Output
Output Connection: a) BNC connector; b) SCART (Euro AV) connector pin 19 (rear)
Impedance: 75Ω
Voltage (V p-p): a) 1V fixed; b) Variable between 0 to 1.5V into 75Ω
Polarity: Negative
Coupling: DC

Chroma

Chroma Standard: PAL B, D, G, H and I and NTSC M
Sub-Carrier Frequency: 4.43 619 MHz for standard PAL B, D, G, H and I; 3.579 545 MHz for standard NTSC M (both coupled to line frequency)
Tolerance: 3 x 10^{-5} (+5° to +40°C)
Burst: Position and number of cycles according to standard
Amplitude: Chroma with burst, fixed 100%, on/off switchable

Chroma Vectors Inaccuracy
Phase: ≤3°
Amplitude: ≤5% relative to luminance amplitude

Synchronization

Line Frequency: 15,625 Hz for CCIR, 15,734 Hz for RTMA
Frequency Tolerance: ≤0.4 Hz (+5° to +40°C)
Number of Lines: 625 for CCIR, 525 for RTMA
Field Frequency: 50 Hz for CCIR, 60 Hz for RTMA
Line + Frame Sync.: According to standard, interlacing
Sync. Signal: Combined signal; line and frame synchronization pulses with amplitude differences
Output: BNC connector (front panel)
Voltage (open circuit): 2.6V for line pulse, 5V for field pulse
Impedance: 6 kΩ
Polarity: Negative

Y/C + RGB Option PM 9553G

RGB signals

RGB Outputs: BNC connectors (rear)
Output Voltage (V p-p): 0.7V into 75Ω
Impedance: 75Ω

Subcarrier Output: BNC connector (rear), only for PAL and NTSC systems
Output Voltage (V p-p): 1V into 75Ω
Impedance: 75Ω

Sync. Output: BNC connector (rear)
Output Voltage (V p-p): 1V into 75Ω
Impedance: 75Ω

PM 5414V

Y/C Signal

Y/C Output: 4-pin S-connector (rear panel)
Y Signal (luminance): Y signal at pin 3, Y ground at pin 1
Impedance: 75Ω
Nominal Output Level: 1V p-p (into 75Ω)
Tolerance: 10%

Standard	B, D, G, H, I	M
Sync. level	-43% ±3%	-40%
Blanking level	0%	0%
Black level	0%	7.5% ±2.5%
White level	100%	100%

C Signal (chroma): Complete chroma signal including color burst of CVBS signal. C signal at pin 4; C ground at pin 2.
Impedance: 75Ω
Output Level Into 75Ω: 100% ±10% for PM 5414V
Setting Value: 0 or 100% switchable for PM 5414V

General Specifications

Power Supply

Line Voltage: 100, 120, 220, 240V, switch selectable
Tolerance: -12% to +10%
Frequency: 50 Hz to 60 Hz
Tolerance: 5%
Power Consumption: 42W

Mechanical Specifications

Size: 300 mm W x 140 mm H x 395 mm L (11.8 in W x 5.5 in H x 15 in L)
Weight: 6.5 kg (14.3 lb)

Ordering Information

Models

PM 5414V Video Pattern Generator (PAL and NTSC)
PM 5414V + Y/C Video Pattern Generator with Y/C + RGB

Included with Instrument
One-year product warranty, line cord, operating manual, Y/C cable for versions with Y/C option.

Accessories (Also see Section 19)
PM 9575 Cable 75Ω BNC-BNC
PM 9553G Y/C + RGB Module
PM 9561G 19" Rack Mount Unit

Manuals
PM 5414V Operator*
PM 5414V Service

**No charge with purchase of unit*

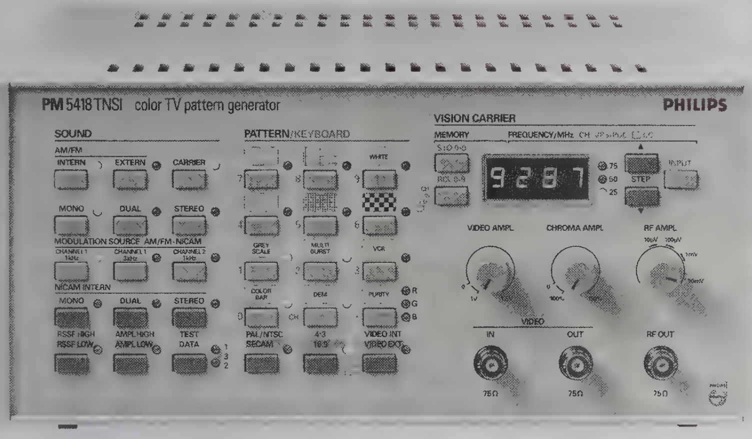
Customer Support Services

Also see Section 20.

Factory Warranty
One-year product warranty.

PM 5415 & PM 5418

GPIB
IEEE-488


PM 5418 TNSI color TV pattern generator
PHILIPS
SOUND
AM/FM
INTERN
EXTERN
CARRIER
MONO
DUAL
STEREO
MODULATION SOURCE AM/FM-NICAM
NICAM INTERN
MONO
DUAL
STEREO
RSSF HIGH RSSF LOW
AMPL HIGH AMPL LOW
TEST DATA
PATTERN/KEYBOARD
WHITE
GREY SCALE
MULTI BURST
VCR
COLOR BAR
DEM
PURITY
PAL/NTSC SECAM
4:3 16:9
VIDEO INT VIDEO EXT
VISION CARRIER
MEMORY
FREQUENCY/MHz
INPUT
STEP
VIDEO AMPL
CHROMA AMPL
RF AMPL
VIDEO
IN
OUT
RF OUT
75Ω
75Ω
75Ω

PM 5418

PM 5415/18 TV Signal Generator Family

- New features: 16:9 Aspect Ratio, PDC and Closed Caption
- Synthesized control of RF frequency
- Covering every RF band from IF to bands IV/V including cable TV bands
- Storage and recall of 10 complete programs, RF freq., pattern and sound settings
- Keyboard call-up of over 100 test patterns/combinations
- Simple TV standard selection of PAL, NTSC or SECAM
- Operation of up to 3 to 4 receivers on a 10 mV output
- Y/C + RGB option
- GPIB/IEEE-488.1 versions with standard Y/C + RGB and universal chroma
  - PM 5418TXI and PM 5418TNSI
- High stability of carriers and sound specifications for all NICAM and IEEE versions

A Pattern for the Future

This family of versatile TV signal generators is designed to cover all available TV standards.

- PM 5415 is for PAL/NTSC
- PM 5418 is for SECAM/PAL/NTSC

All models are microprocessor-controlled with non-volatile memories, allowing pre-determined user-programs to be stored and recalled at the touch of a key.

Over 100 different patterns and combinations are achievable, as well as Teletext, FM stereo and NICAM sound. All modes are very simple to set up.

Each model in the series is available in a basic configuration, and also with enhanced versions to handle the widest possible spectrum of applications. These are listed at the end of this section. For servicing of color TV monitors and applications involving computer graphics, an Y/C + RGB option is available. System versions, the TXI and TNSI, with GPIB/IEEE-488.1* interface built-in, Y/C + RGB, and universal chroma as standard, are also available.

Thus many of today's video testing problems are well covered, with reserve capability ready for tomorrow's needs.

Versatility with Ease

The PM 5415/18 series offers you unparalleled versatility and ease of use.

Thanks to microcomputer control, one simply keys-in the programs required — R.F. frequency setting, pattern selection and sound modulation. Touch a button to store them — ready for recall. And, even a year later, just recall and the program is still there — ready for immediate use. Versatility plus simplicity.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Lowest Cost of Ownership

Microprocessor control offers more than versatility with ease. It offers security and reliability. Software modules and solid-state memories take over from mechanical switches, reducing service and maintenance costs to the absolute minimum. And with built-in quality and reliability the user can be sure of low cost of ownership.

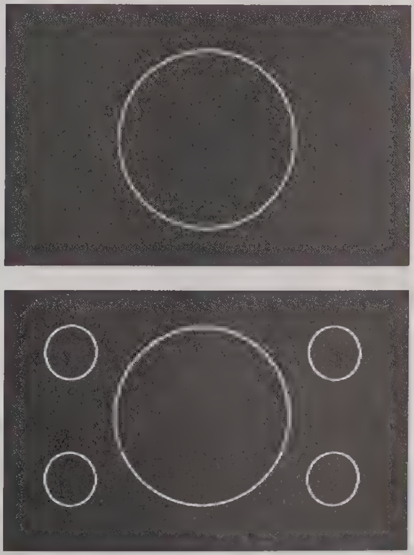
An Unparalleled Range

The PM 5415/18 series offers an unparalleled range of pattern generators. From the versatile basic model with its touch-button control of every parameter, through models offering FM-stereo, NICAM and Teletext test and page signals, up to the model that offers everything! A range from which one can choose a pattern generator for today - knowing that it will meet tomorrow's needs.

Patterns for Now and for the Future

Twelve push-buttons make the selection of eighteen different patterns possible. These test patterns check and align the luminance and chrominance circuitry of the color TV monitors and VCRs.

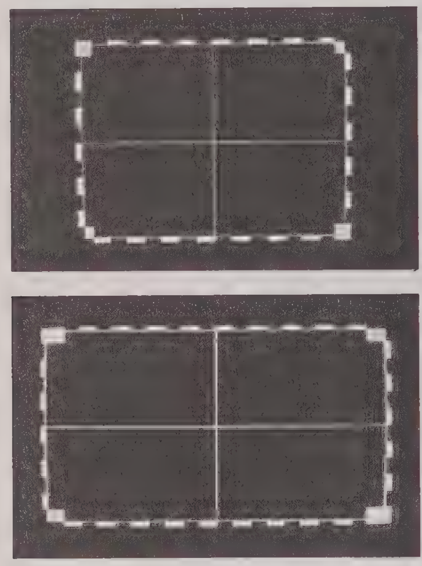
Every test pattern is available in 16:9 and 4:3 Aspect Ratio format. With the 16:9 push-button the required Aspect Ratio is selected.



Circle on a black background for checking the overall linearity and geometry. The white circle changes automatically to black when used with the white pattern and is useful for checking reflections.

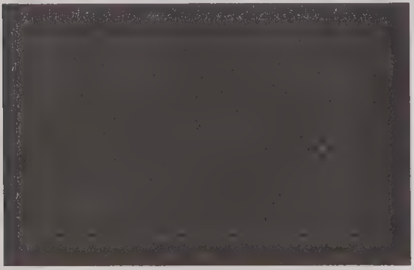
In 16:9 Aspect Ratio format, small circles are present in the corners of the screen.

PM 5415 & PM 5418

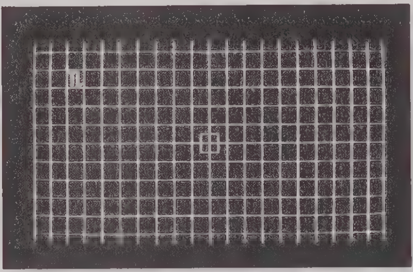


Center Cross/Border castellations are ideal for centring TV monitors and TV screens. Also to check the deflection linearity and for pin-cushion correction.

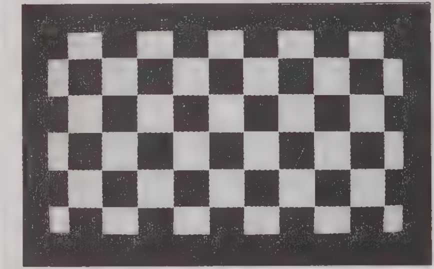
White 100% with swinging burst is designed for setting white D and for an overall check of purity. Also for beam current adjustment. White D is the correct white necessary for a natural color reproduction.



Dot pattern mainly for static convergence. The screen should contain pure white dots.

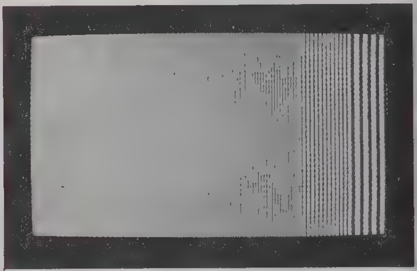


Cross Hatch/Center Indication/Top-Left Indication with either 17 (4:3) or 21 (16:9) vertical and 11 horizontal lines is used for checking and re-aligning dynamic and corner convergence. The advantage is that there is no interlacing which would normally tire the eyes. If interlacing is required this can be achieved by superimposing another pattern such as center cross, circle or dots.

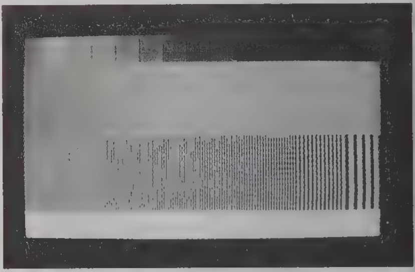


Checkerboard pattern of six times eight (4:3) or six times ten (16:9) columns of squares provides a visual standard for basic picture tube alignments, for example: centring, focus, horizontal and vertical deflection and linearity.

Grey scale Full-screen linear staircase signal with 8 equal steps from black to white is used to locate faulty linearity of the video amplifier or grey-scale setting.



Multiburst contains eight full screen vertical bars of definition lines in the frequency ranges 0.8, 1.8, 2.8, 3.0, 3.2, 3.4, 3.8 and 4.8 MHz. This checks the bandwidth of the video or luminance amplifier in black and white or color TV as well as the resolution of monitors and video recorders.



VCR is a specially-designed test pattern to check the bandwidth, linearity, sensitivity and AGC of the chroma amplifiers in color video recorders.

This combined test pattern is divided into 4 horizontal segments:

- 24 lines of 100% white level.
- Eight bars of resolution of which 2.8 - 3.0 - 3.2 - 3.4 MHz are used to align the high-pass filter for a maximum resolution in VCR bandwidth.
- Eight steps of decreasing linear levels of saturation from 100 to 0% to check the chroma amplifier linearity and color AGC circuitry.
- A black horizontal bar with a moving white field to check moving pictures on video recorders

PM 5415 & PM 5418

Purity with a choice of the three primary colors clearly indicated by LEDs. The red pattern is used for checking color purity. The green pattern provides a purity check for three-in-line tubes. Blue is also available to check color performance. The three complementary colors, magenta, yellow and cyan can also be displayed by selection, as can white and black.

Combinations with circle and/or centre cross are easy to select.

Color bar standard bar pattern. The vertical bars are white D, yellow, cyan, green, magenta, red, blue and black.

Since it is dependent on the TV system selected, the luminance contents is automatically corrected for each setting.

The color bar pattern therefore provides sufficient information for a good overall check of color performance, including checks on burst keying, subcarrier regeneration, RGB amplifiers, the delay color versus B/W signal and saturation.

DEM Pattern. Demodulator is a combined test pattern which, divided in 4 sections, contains information to make on-screens checks and alignments of the color demodulators and sub-carrier frequency. For PAL it is used to check the chroma delay line for amplitude and phase (venetian blinds). For the NTSC system, the pattern is according to the NTSC requirements and contains 7 color bars, -I and +Q signals and a black and white reference field.

DEM pattern for PAL systems

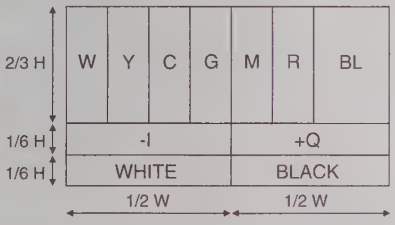
G - Y = 0*		Y = 50%	
Δ* + (R - Y)	Δ* - (R - Y)	◊* + (B - Y)	◊* - (B - Y) *
Δ** ± (R - Y)	Δ** ∓ (R - Y)	◊** ± (B - Y)	◊** ∓ (B - Y)
Reference Y = 50%			

Δ (B - Y) = 0 ◊ (R - Y) = 0

** PAL coded*

*** Anti-PAL coded*

DEM pattern for NTSC systems



Stereo and Second Sound Channel

All versions of the PM 5415 and PM 5418 have standard mono sound according to the selected TV system.

For use in standard CCIR, PAL B and G systems, the PM 5415 and PM 5418 have a selection of optional -TX, -TXS and -TXI configurations with two sound carriers for use in one- and two-channel mode, or right and left channel of a stereo signal. They are therefore appropriate for European systems (and are not compatible with BTSC (NTSC) stereo systems).

CTV transmission with stereo sound or alternative second sound channel (e.g. to choose between synchronized or original voice tracks) is becoming more common. The -TX, -TXS and -TXI meet the need for a portable TV signal generator for test and realignment of these receivers.

The instrument allows external modulation from a full stereo tuner/amplifier, tape or cassette recorder, with PM 5415/18 as the RF modulator.

NICAM Digital Sound

Specific benefits of the NICAM generators include the ability to select more than 55 digital sound test signals instantly at any time, thereby speeding and simplifying operation. Subcarrier and sound carrier signals have an exceptionally high stability of within 2 p.p.m. up to an order of magnitude better than other comparable generators.

NICAM is compatible with the existing PAL types B, G and I terrestrial TV and cable TV standards, and adds two high-quality digital sound channels. Suitable TV sets can receive two mono channels for simultaneous translation of foreign-language programmes, stereo, or transparent transmission of data.

The NICAM color pattern generators equipped with digital filters provide a number of test signals for NICAM TV receivers and QPSK demodulators. The two digital sound channels have selectable low- or high-amplitude signals to test the expander of the TV receiver. Standard 1 kHz tones check the sound channels, and a 3 kHz tone on channel 1 can test the stereo or dual-sound performance of the TV.

Three special test signals (Data 1, 2 and 3) are available to check the operation of the demodulator and decoder. An RSSF (Reserve Sound Switching Flag) is high/low selectable to indicate that the analog and digital sound carriers are transmitting different information, or to indicate faults in the digital transmission.

Signals generated by the -TN, -TNS and -TNSI versions allow measurements and alignment of NICAM decoders.

Standard these versions have also FM stereo sound identical to the -TX(S)(I) versions.

Teletext

The growth of electronic communications has seen a rapid increase in the introduction of text transmission. To meet the highly specialized requirements for the checking and alignment of teletext receivers and decoders the -TX(S)(I) and -TN(S)(I) configurations have been specially developed. These instruments offer the facility of a selection of over ten teletext pages with special contents for decoder testing.

The DIDON ANTIOPE teletext signal is also standard available. Via a switch (rear side) selection between DIDON ANTIOPE or UK Teletext is possible.

FLOF, TOP and VPT

The test facilities of the PM 5415/18 teletext versions have been extended by a selection of teletext pages including normal teletext, FLOF (Full Level One Features), TOP (Table of pages) and VPT (Video Programming by Teletext). FLOF is used in the UK, while TOP is used in Germany, Switzerland and Austria, as well as via cable distribution systems in the Netherlands. TOP and FLOF also feature extra country characters.

VPT provides a menu that makes VCR programming simple, allowing programmes to be selected by setting the start and stop time.

PDC/VPS Test Facilities

PDC and VPS are control informations sent by the broadcaster and are used to synchronize the recording on a VCR with the transmitted program.

PM 5415 & PM 5418

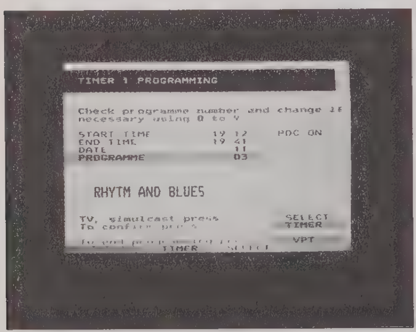
The -TXS and - TNS(I) models offer complete testing of video cassette recorders equipped with PDC / VPS under the PAL B, G, H, I, D and N standards. A maximum of 9 coded PDC / VPS signals are available.

With PDC the PIL (date & time), CNI (country & network) and PTY are programmable. PCS is according the selected sound mode (mono, dual or stereo). Other parameters are only remote programmable (only for IEEE versions).

Special signals as timer control code, recording inhibit/terminate code, interruption code and continuation code can also be selected.

In VPS mode, date, transmission time, country indication, TV channel, stereo/dual/mono sound and adult/general information is present. Special signals such as LEER code, program interrupt and system status can also be selected.

PDC / VPS data is shown in a 1/6 screen height horizontal bar which can be combined with any test pattern and displayed in six positions, either on- or off-screen. Unique to PDC / VPS instruments is on-screen display of codes and programming the generator to set codes locally if required.



TIMER 1 PROGRAMMING

Check programme number and change if necessary using 0 to 9

START TIME 19 12 PDC ON
END TIME 19 41
DATE 11
PROGRAMME 03

RHYTM AND BLUES

TV, simulcast press SELECT
To confirm press TIMER

VPT

TIMER SELECT

Closed Caption

Closed Caption is used to provide a visual depiction of information simultaneously being provided on the audio portion of a television signal. In the USA it is determined by law that TV receivers manufactured after 1st of july 1993 must have a Closed Caption decoder standard built-in.

The -TXS and -TNS(I) models provide the Closed Caption facility for testing these decoders.

The PM 5415/18 offer both Caption and Text modes in either of two operating channels. The Closed Caption information is present in line 21 of the NTSC video signal.

The -TXS and -TNS(I) offer factory pre-coded Closed Caption information with a selection of 8 different informations. Selection of the required test option is similar with the PDC / VPS system.

Additionally, memory 9 is an automatic Closed Caption sequence of memories 1 up to 8.

RF Selection

All models cover the full frequency range from 32 to 900 MHz, including IF and TV transmissions in frequency bands I, III, IV and V. Selection of the synthesized RF frequency is electronic, via the keyboard.

Up to ten memory places can be used either to store the selected RF frequency or TV channel number. Having stored, e.g. the local TV stations, any one of them can be recalled at the touch of a button without time consuming dial tuning.

The RF carrier output of >10 mV into 75Ω is ample for 3 or 4 receivers in parallel during workshop repairs, and the carrier can be continuously attenuated by more than 60 dB, with output indications at 1 mV, 100 μV and 10 μV levels. The ability to smoothly vary the RF level is of particular value when checking the overall RF sensitivity or AGC circuits.

RF Carrier and Frequency Spectrum

Although double sideband, the RF envelope of the PM 5415/18 is very similar to that transmitted by professional TV broadcast companies, such as, e.g., 13 dB for TV standard G between the sound and vision channels. (Most other generators have 25 dB or more separation, leading to false impressions when aligning tuners and RF amplifiers.)

The System Switch

The rear of the instrument offers additional facilities which add to the uniqueness of the PM 5415/18 range. A selection switch is used to choose the TV system required. Line frequency is automatically selected, either 15 625 Hz for CCIR or 15 734 Hz for RTMA with less than 0.4 Hz frequency tolerance.

The correct crystal for color and subcarrier, determining line- and frame-frequencies, is selected automatically.

Outputs

The Euro-AV/SCART connector for audio/video out as well as the DIN connector for external audio modulation are standard for all models. The Euro-AV/SCART connector provides also the desired status voltage for CVBS status (for 4:3 as well as 16:9 Aspect Ratio) at pin 8.

Y/C + RGB Option PM 9553G

TV signal generators get S-VHS capability.

An optional Y/C + RGB module gives the PM 5415/18 range of TV signal generators the separate luminance and chroma (Y/C) outputs needed by the new-generation S-VHS video recorders and Y/C monitors. By separately recording the Y and C signals, these VCRs eliminate cross-color effects to give dramatically improved color reproduction. The PM 9553G Y/C + RGB module can be retro-fitted to any of the PM 5414V, PM 5415 and PM 5418 TV signal generators, and provides output signals to the S-VHS VCR or Y/C monitor via a special connector.

RGB signals and a SYNC and subcarrier facility are available to meet the rapid advance in computer graphics techniques and servicing of color video monitors. There are many monitors which only accept RGB signals and for testing these the RGB option is essential.

Color subcarrier and sync signal are supplied as standard (BNC connectors) for PAL and NTSC systems.

IEEE-488.1 Versions

For use in systems applications, two of the PM 5418 models are configured with an IEEE/IEC interface. All the available TV and sound modulation standards can be selected remotely, and "bus learn mode" and "identification mode" are included. See page 370 for more information about the IEEE-488.1/IEC versions PM 5418TXI and PM 5418TNSI.

A Range for Today and Tomorrow

The versatility of the Philips TV signal generator family not only ensures that today's requirements are expertly met but the developments of tomorrow are anticipated.

PM 5415 Generator For PAL/NTSC

The standard PM 5415 generator with its advanced features, unrivalled in the market place, is complemented by four enhanced models:

PM 5415TX offers teletext pages for aligning and testing teletext receivers and decoders. It features also full additional FM stereo and dual sound channel facilities according to system B and G.

PM 5415TXS further expands on the -TX version by adding PDC / VPS for PAL and Closed Caption for NTSC.

PM 5415TN offers, in addition to all facilities of the -TX model, NICAM digital sound for PAL B, G and I.

PM 5415TNS further expands on the -TN version by adding PDC / VPS for PAL and Closed Caption for NTSC.

PM 5418 Generator For SECAM/ PAL/NTSC

The PM 5418 expands on the basic PM 5415 by supporting not only the NTSC and PAL TV standards, but also SECAM.

The SECAM systems B, D, G, H and K1 (with negative video modulation and FM sound) as well as system L (with positive video modulation and AM sound) are supported.

In addition, it adds IEEE-488.1 compatibility as an optional configuration for system applications. As such, it is the most advanced color pattern generator.

PM 5415 & PM 5418

A push-button on the front panel selects PAL or SECAM, with a rear panel switch to select NTSC.

In addition to the standard PM 5418, enhanced versions include:

PM 5418TX has the same functionality as the PM 5415TX with the SECAM TV system added.

PM 5418TXS further expands on the -TX version by adding PDC / VPS for PAL and Closed Caption for NTSC.

PM 5418TN offers, in addition to all facilities of the -TX model, NICAM digital sound for PAL B, G and I.

PM 5418TNS further expands on the -TN version by adding PDC / VPS for PAL and Closed Caption for NTSC.

PAL and NTSC TV Systems Specifications for PM 5415 and PM 5418

Systems	**M**	**B,G &H**	**D**	**I**	**N**	**M**
TV and chroma standard	NTSC, RTMA	CCIR, PAL	CCIR, PAL	CCIR, PAL	CCIR, PAL	RTMA, PAL
No. of lines per picture frame	525	625	625	625	625	525
Field frequency (Hz)	60	50	50	50	50	60
Line frequency (lines/second)	15734	15625	15625	15625	15625	15734
Chrominance subcarrier (MHz)	3.579545	4.433619	4.433619	4.433619	3.582056	3.575611
Sound carrier to vision carrier (MHz)	4.5	5.5	6.5	6	4.5	4.5
Sound modulation	FM	FM	FM	FM	FM	FM
Pre-emphasis (µs)	75	50	50	50	75	75

SECAM TV System Specifications For PM 5418

TV systems	SECAM B, G, H	SECAM D, K, K1	SECAM L
Sound carrier relative to vision carrier (MHz)	5.5	6.5	6.5
Type and polarity of video modulation	A3F neg.	A3F neg.	A3F pos.
Type of sound modulation	FM	FM	AM
Chrominance subcarrier (MHz)	F_{OB} = 4.250000 F_{OR} = 4.406250		
Type of chrominance subcarrier modulation	Frequency modulation		
Transmitted chrominance information	Line sequential D'R and D'B		
Line frequency (lines/second)	15625		
Field frequency (Hz)	50		

Quick Selection Guide

Type number	PAL B D G H I	PAL M N PM 9546	NTSC M M:4.43	SECAM B D G H K K1 L	RF	Stereo	Teletext TOP/FLOF	UK TXT Antiope	NICAM	VPS/PDC/CC	IEEE	Y/C+RGB PM 9553G
PM 5414 V	•	opt 1	•									opt 2
PM 5415	•	opt 1	•		•							opt 2
PM 5415 TX	•	opt 1	•		•	•	•	•				opt 2
PM 5415 TXS	•	opt 1	•		•	•	•	•		•		opt 2
PM 5415 TN	•	opt 1	•		•	•	•	•	•			opt 2
PM 5415 TNS	•	opt 1	•		•	•	•	•	•	•		opt 2
PM 5418	•	opt 1	•	•	•							opt 2
PM 5418 TX	•	opt 1	•	•	•	•	•	•				opt 2
PM 5418 TXS	•	opt 1	•	•	•	•	•	•		•		opt 2
PM 5418 TN	•	opt 1	•	•	•	•	•	•	•			opt 2
PM 5418 TNS	•	opt 1	•	•	•	•	•	•	•	•		opt 2
PM 5418 TXI	•	•	•	•	•	•	•	•			•	•
PM 5418 TNSI	•	•	•	•	•	•	•	•	•	•	•	•

• =standard in instrument opt = optional available: opt 1 = PM 9546 = Universal PAL/NTSC chroma module - opt 2 = PM 9553G = Y/C+ RGB module

PM 5415 & PM 5418

The PM 5418TXI and PM 5418TNSI are the most advanced color pattern generators in Philips' range. The functionality of the PM 5418TXI is equivalent to a PM 5418TX and the functionality of the PM 5418TNSI is equivalent to the PM 5418TNS. These products are designed specifically for systems use and comes with an GPIB/IEEE-488.1 interface as standard. The PM 5418TXI and PM 5418TNSI are the most versatile general purpose instruments for testing and adjustment of TV sets, monitors and video recorders, in virtually any systems (or standalone) application in development, production and service.

The IEEE interface allows remote selection and control of all the functions and allows operation in automatic test environments. "Identification mode" and bus "learn mode" are implemented in the PM5418TXI and PM 5418TNSI.

These units support all PAL/SECAM/NTSC TV standards, including PAL M & N. Also included are teletext, antiope, composite video outputs and sound modulation in stereo, dual channel and mono. In addition, they have included as standard the universal chroma and Y/C+RGB facilities available.

The PM 5418TNSI offers also NICAM digital sound, PDC/VPS programming codes and Closed Caption subtitling information.

These systems-oriented instruments are often used continuously in factory set-ups, so the crystal oscillators and derived frequencies have a higher stability and accuracy than the standard models.

Specifications

Technical Specifications

All specifications are valid for temparature range from +5°C to +50°C

Video Carrier

Frequency
Range: 32 to 900 MHz
IF = Band I: 32 to 90 MHz
S-Band S1-S10: 104 to 174 MHz
Band III: 174 to 230 MHz
S-Band S11-S20: 230 to 300 MHz
Hyperband H21-H40: 300 to 470 MHz
Band IV-V: 470 to 900 MHz
Frequency Selection: Keyboard
Fine Tuning: 250 kHz steps for TV frequencies 100 kHz steps for IF frequencies (32 to 44.9 MHz)
Frequency Tuning: In positive or negative direction. Tuning speed increase by holding step button.
Storage:
a) Possibility for 10 different RF frequencies
b) As a), indicated as TV channel numbers
Indication: 4-digit 7-segment LED display
a) First digit: memory, store and recall position 0 to 9
b) 2nd, 3rd and 4th digits: 3-digit indication of frequency in MHz. Separate indication for 250 kHz, 500 kHz and 750 kHz steps.
c) Keyboard-selectable TV channel numbers (e.g. C21 or C70)

RF Output

RF Output: BNC connector (front panel)
Impedance: 75Ω
Output Voltage: <10 mV ±2 mV
Attenuation: 60 dB, continuous

Video

Video Modulation
Modulation: AM internal-external switchable
Polarity: Negative/positive for SECAM L

Video Input
Video Input: BNC connector (front panel)
Input Voltage (V p-p): 1V
Maximum Permissible Input Voltage: ±5V
Impedance: 75Ω
Polarity: White level positive
Coupling: DC (clamping on sync.)

Video Outputs

a) BNC connector
b) SCART connector (Euro-AV connector), pin 19 (rear)
Impedance: 75Ω
Voltage (V p-p): a) 1V fixed; b) Variable between 0 to 1.5V/75Ω
Polarity: Negative
Coupling: DC

Chroma (NTSC/PAL)

Chroma Standards: NTSC according to system M (switchable); PAL according to system B, D, G, H, I, (M, N)
Selection: Rear panel thumbwheel system switch
Sub-Carrier Frequency:
3.579545 MHz for NTSC
4.433619 MHz for PAL B, D, G, H, I;
3.575611 MHz for PAL M;
3.582056 MHz for PAL N;
Sub-carrier frequencies coupled to line frequency according to selected standard
Tolerance: $\leq 3 \times 10^{-5}$
Burst: Position, number of cycles and phase according to selected standard
Amplitude: Chroma with burst
a) Fixed (100%)
b) Continuously variable from 0 to 150%
Chroma Vectors Inaccuracy
Phase: ≤3°
Amplitude: ≤5% relative to luminance amplitude

Chroma PM 5418TXI and PM 5418TNSI: As above but with PAL M,N as standard

Chroma PM 5415TN(S), PM 5418TXI and PM 5418TN(S)(I)
Tolerance: 2×10^{-6}
Aging: 2×10^{-6}/year

Chroma (SECAM)

Chroma Standards: SECAM B, D, G, H, K, K1 and L
Selection: Rear panel thumbwheel system switches
Chrominance Sub-Carrier (MHz): $f_{OB} = 4.250000$
$f_{OR} = 4.406250$
Tolerance: <2 kHz
Type of Chrominance Sub-Carrier Modulation: Frequency modulation
Transmitted Chrominance Information: Line-sequential D'R and D'B
Signals: D'R = -1.9 (E'R - E'Y)
D'B = 1.5 (E'B - E'Y)
Amplitude:
- Fixed, according to standard
- Variable from 0 to 150%

Frequency Deviation: Of chrominance subcarrier according to TV standard
Video Pre-Emphasis: Low frequency pre-correction and high-frequency bell filter according to TV standard
Bell Center Frequency: 4.286 MHz
Tolerances: ≤20 kHz

Chroma (SECAM) PM 5418TXI and PM 5418TN(S)(I)
as above except:
Tolerance: 2×10^{-6}
Aging: 2×10^{-6}/year

Synchronization

Line Frequency: 15,734 Hz (RTMA), 15,625 Hz (CCIR),
Frequency Tolerance: ≤0.4 Hz
Number of Lines: 525 (RTMA), 625 (CCIR),
Field Frequency: 60 Hz (RTMA), 50 Hz (CCIR),
Line and Frame Sync.: According to TV standard, interlacing
Output: BNC connector (front panel)
Sync. Signal: Combined signal with line and field synchronization pulses with amplitude difference
Voltage (open-circuit): 2.6V for line pulse, 5.0V for field pulse
Impedance: 6 kΩ
Polarity: Negative

Synchronization SECAM

Identification: According to TV system in line and frame
Frame Identification: Position in lines 7 to 15; in 1st, 3rd and 5th field etc.: in lines 320 to 328; in 2nd, 4th and 6th field etc.

Line Identification: By burst (chrominance subcarrier reference signal) on the back porch according to TV standard (SECAM B, D, G, H, K, K1, L)
Amplitude: Line and frame identification according to TV standard, but also variable between 0 to 150% together with chroma information

Sound Carrier and Modulation

Sound Carrier (mono): On/off switchable
Frequency: 4.5 MHz, standard M, N;
5.5 MHz, standard B, G, H;
6.0 MHz, standard I;
6.5 MHz, standard D, K, K1 and L
Tolerance: ≤3 x 10^{-5}
Vision/Sound Carrier Ratio:
13 dB, standard B, G, H;
11 dB, standard D, K, K1, L;
13 dB, standard M, N;
12 dB, standard I
Sound Modulation: FM, internal and external on/off switchable, AM for SECAM L
Pre-Emphasis: 50 µs standard B, D, G, H, I, K, K1; 75 µs standard M, N

Internal FM
Frequency Deviation:
±30 kHz, standard B, G, H;
±15 kHz, standard M, N;
±27.5 kHz, standard I;
±24 kHz, standard D, K, K1
Modulation Depth: 50%, standard SECAM L

External FM
0.4V will give the same deviation or modulation depth as with internal modulation
Input: DIN connector, pin 3 + 5 (rear panel)
Impedance: 0.5 MΩ
Bandwidth: 40 Hz to 15 kHz
Maximum Input Voltage: ±40V
Output: SCART connector (Euro-AV connector), pin 3 (rear panel)
Impedance: 1 kΩ
Voltage: 0.4V

Sound Section for Stereo and Second Sound Channel Transmission for TX(S)(I) and TN(S)(I) Versions

Standards: B, G
Sound Carriers: Carrier 1: 5.5 MHz;
Carrier 2: 5.7421875 MHz
Vision Sound Carrier Ratio: Carrier 1: 13 dB;
Carrier 2: 20 dB
Frequency Tolerance:
<3 x 10^{-5} for standard models
<2 x 10^{-6} for TXI and TN(S)(I) models
Modulation: FM, internal and external on/off switchable
Pre-Emphasis: 50 µs

Internal FM

Sound Channel 1: 1 kHz on/off switchable;
3 kHz on/off switchable
Deviation: ±30 kHz in mono/dual-channel
±15 kHz in stereo, right channel switched off
±30 kHz in stereo, left and right channels switched on with 1 kHz internal signal
Sound Channel 2: 1 kHz, on/off switchable
Deviation: ±30 kHz

External FM

Sound Channels 1 & 2 Input Voltage: 0.4V will give the same deviation as the internal signal
Inputs: DIN connector (rear panel)
Contacts: Pin 2 (ground),
pin 3 sound channel 1,
pin 5 sound channel 2
Impedance: 0.5 MΩ
Bandwidth: 40 Hz to 15 kHz
Maximum Permissible Voltage: ±40V

Outputs

SCART connector (Euro-AV connector)
Contacts: Pin 3 sound channel 1, pin 1 sound channel 2
Impedance: 1 kΩ
Voltage: 0.4V

Operating Mode Detection

Pilot Frequency: 54.6875 kHz (3.5 x f_H)
Tolerance: <3 x 10^{-5} for standard models
<2 x 10^{-6} for TXI and TN(S)(I) models
Modulation: AM
Modulation Depth: 50%
Identification Frequencies: 117.5 Hz (f_H/133) stereo mode; 274.1 Hz (f_H/57) dual-channel mode
Deviation of 2nd Sound Carrier: ±2.5 kHz by modulation of carrier with unmodulated pilot. For standards D, I, M, N all stereo versions also offer all mono facilities.

Sound Section for NICAM Digital Sound Transmission TN(S)(I) Versions

AM/FM sound: As for PM 5415 TX and PM 5418 TX(I) versions
MONO, DUAL, STEREO: As for PM 5415 TX and PM 5418 TX(I) versions with the following additions and changes:
Modulation of the AM/FM sound carrier with NICAM off: As for PM 5415 TX / PM 5418 TX(I)
Modulation of the AM/FM sound carrier with NICAM on: AM/FM MONO carrier remains; FM STEREO carrier off

Internal

MONO and DUAL: Same contents as NICAM channel 1
STEREO: Sum of NICAM channels 1 and 2
FM Deviation: ±30 kHz
Test: Modulation off

External

As for PM 5418, MONO sound RSSF (Reserve Sound Switching Flag) automatically set to LOW

Digital Sound Section (NICAM)

Sound Carrier: 'On/off' switchable by selecting/deselecting the NICAM modes MONO, DUAL, STEREO, TEST
Frequency: System B, G: 5.85 MHz; System I:6.552MHz. Related to bit-rate clock. Automatically matched to chosen TV system
Tolerance: 2 p.p.m.
Amplitude: -20 dBc (related to video carrier)
Tolerance: ±2 dB
Modulation: Quadrature phase shift keying (QPSK)
Modes: MONO, DUAL, STEREO, TEST selectable

Internal Sources

Channel 1: 1 kHz or 3 kHz sine wave, selectable 'on/off' switchable
Channel 2: 1 kHz sine wave 'on/off' switchable
Amplitude: Two different amplitudes selectable by AMPL LOW key; FM deviation of AM/FM MONO carrier remains at ±30 kHz
Amplitude High: Reference is the maximum codeable amplitude at 15 kHz. 1 kHz and 3 kHz amplitudes are attenuated relative to this level according to pre-emphasis CCITT Rec. J17.
Amplitude Low: 1/3 of high amplitude
Reserve Sound Switching Flag (RSSF): High/low selectable by RSSF LOW key. High/low selectable for all NICAM modes. Content of the FM modulated carrier is different from the QPSK modulated NICAM carrier, but it is not indicated.
Test 1: NICAM demodulator test
Test 2: NICAM decoder test
Test 3: Unmodulated NICAM carrier
Sound Coding: 10 bits/sample and 32 samples/block according to NICAM-728
Bit Rate: 728 kbit/s ±2 p.p.m.
Pre-Emphasis: CCITT Rec. J17
Spectrum Shaping: System B, G: 40% cosine roll-off; System I: 100% cosine roll-off
NICAM Data Output: BNC rear panel
Data Format: According to NICAM-728
Data Level (V p-p): 1V at 75Ω
Output Impedance: 75Ω
NICAM Clock Output: BNC rear panel
Frequency: 728 kHz ±2 ppm
Clock Amplitude (V p-p): 1V at 75Ω
Output Impedance: 75Ω
Analog Output: Euro-AV connector (SCART) rear panel
Impedance: 1 kΩ
Output Voltage (rms): 0.4V
Internal Modulation
Pin 3: Contents of channel 1
Pin 1: Contents of channel 2

PM 5415 & PM 5418

For RSSF Flag Low (both pins): Modulation contents of the FM MONO channel
External Modulation of FM Carrier Combined with NICAM Sound: RSSF (Reserve Sound Switching Flag)automatically set to LOW
Pin 3: Signal supplied to pin 3 of the AUDIO IN connector
Pin 1: Signal supplied to pin 5 of the AUDIO IN connector

Teletext for TX(S)(I) and TN(S)(I) Versions

Data Synchronization Frequency:
PAL BGI-6.9375 MHz, 444 x f_H;
SECAM L-6.203125 MHz, 397 x f_H
Data Coding: Acc. to standards
Signal Levels:
PAL: '1' = 66% of white level, '0' = black level
SECAM: '1' = 100% of white level, '0' = black level
Signal Shaping: Cos^2 filter
Data Lines: 20, 21, 333, 334 and (with internal solder bridge, UK TXT only) 13, 14, 326 and 327
Data Contents: Text pages with special contents for decoder testing for each standard
Normal Working Mode: Combinations possible with all test patterns

Signal Output
Teletext Signal Combined with Video Signal: On all CVBS outputs
Modulated RF Signal: RF output, RF from basic unit

PDC/VPS for -TXS and -TNS(I) Versions

PDC
Program Delivery Control is a data broadcasting system which carries program related information for exploitation by suitable-equipped domestic video recorders according to the EBU specification SPB 459 Revision 2
Data Synchronization Frequency: 6.9375 MHz
Modulation: Binary NRZ
Data Coding: Acc. to standard
Location of Data: Lines 20, 21, 333, 334 and (with internal solder bridge, UK TXT only) 13, 14 326 and 327
Signal Levels: '0' = 0V, '1' = 66% of white level
Signal Shaping: Cos^2 filter
Data Contents: 9 different sets of PDC data of which 4 are freely programmable
Normal Operating Mode: Combination possible with all test patterns (except cross hatch pattern) and teletext; on/off switchable
Programming: Via keyboard and text strip inserted in the test pattern
Text Strip: 6 different positions or not visible

VPS
Video Programming System for pre-programmed recording with home video recorders according to German broadcasting organizations ARD, ZDF and ZVEI
Data Synchronization Frequency: 5 MHz
Bit Length: 400 ns
Modulation: Bi-phase modulation
Data Coding: According to the guideline issued by ARD, ZDF and ZVEI
Signal Levels: '0' = black level, '1' = 71.4% of white level
Signal Shaping: Cos^2 filter
Location of Data: Line 16 (VPS system)
Data Contents: 9 different freely programmable non-volatile sets of VPS data preset at factory
Normal Operating Mode: Combination possible with all test patterns (except cross hatch pattern) and teletext; on/off switchable
Programming: Via keyboard and text strip inserted in the test pattern
Text Strip: 6 different positions, or not visible

Closed Caption for -TXS and -TNS(I) Versions

Closed Caption is a subtitling system used in the USA (NTSC M)
Data Synchronization Frequency: 503,4965 kHz (32 * f_H)
Data Coding: Binary NRZ
Signal Levels: '0' = blanking level; '1' = 50 IRE level
Signal Shaping: filtered to a 2T response
Location of Data: line 21 of field 1 in the NTSC M system
Data Contents: 7 cycle sine wave clock run-in burst, start bit and 16 data bits
Display Modes: Pop Up Mode, Roll Up Mode and Text Mode
Second Language: Available
Data Informations: 8 pre-defined Closed Caption data sets, non-programmable. 1 sequence of these 8 pre-defined data sets is possible.

IEEE-488.1 Interface for PM 5418TXI and PM 5418TNSI Versions Only
Allows selection and control of all functions

Y/C + RGB Option PM 9553G

RGB Signals

RGB Outputs: BNC connectors (rear)
Output Voltage (V p-p): 0.7V into 75Ω
Impedance: 75Ω
Subcarrier Output: BNC connector (rear), only for PAL and NTSC systems
Output Voltage (V p-p): 1V into 75Ω
Impedance: 75Ω
Sync. Output: BNC connector (rear)
Output Voltage (V p-p): 1V into 75Ω
Impedance: 75Ω

Y/C Signal

Y/C Output: 4-pin S-connector (rear panel)
Y Signal (luminance): Y signal at pin 3, Y ground at pin 1
Impedance: 75Ω
Nominal Output Level: 1V p-p (into 75Ω)
Tolerance: 10%

Standard	B, D, G, H, I	M
Sync. level	-43% ±3%	-40%
Blanking level	0%	0%
Black level	0%	7.5% ±2.5%
White level	100%	100%

C Signal (chroma): Complete chroma signal including color burst of CVBS signal; C signal at pin 4; C ground at pin 2
Impedance: 75Ω
Output Level into 75Ω: Normal value 100% ± 10% in stop position CHROMA AMPL. for PM 5415 and PM 5418
Setting value: 0 to 150% continuously adjustable for PM 5415 and PM 5418

Universal PAL/NTSC Chroma Module

NTSC Systems: M
PAL Systems: B, D, G, H, I, M, N

General Specifications

Line Voltage: 100, 120, 220, 240V, switch selectable
Tolerance: -12% / +10%
Frequency: 50 Hz / 60 Hz
Tolerance: 5%
Power Consumption: Depends on version

Mechanical Data

Size: 300 mm W x 140 mm H x 395 mm L (11.8 in W x 5.5 in H x 15 in L)
Weight: Approx. 10 kg (22 lb) (depending on version)

Ordering Information

Models

PM 5415 NTSC/PAL TV Signal Generator
PM 5418 NTSC/PAL/SECAM Pattern Generator

Included with Instrument
One-year product warranty, PM 9538 RF cable - BNC TV connector, line cord, operating manual, Y/C cable for versions with Y/C option.

Optional Configurations
PM 5415 Y/C+RGB Standard PM 5415 plus Y/C+RGB
PM 5415TX Standard PM 5415 plus PAL B, G stereo and teletext
PM 5415TX Y/C+RGB Same, plus Y/C+RGB
PM 5415TXS As PM 5415 TX plus PDC/VPS and Closed Caption
PM 5415TXS Y/C+RGB Same, plus Y/C+RGB
PM 5415TN As PM 5415 TX plus PAL B, G, I NICAM
PM 5415TN Y/C+RGB Same, plus Y/C+RGB
PM 5415TNS As PM 5415 TN plus PDC/VPS and Closed Caption

PM 5415 & PM 5418

PM 5415TNS Y/C+RGB Same, plus Y/C+RGB
PM 5418 Y/C+RGB Standard PM 5418, plus Y/C+RGB
PM 5418TX Standard PM 5418 plus PAL B, G stereo, teletext, and DIDON antiope
PM 5418TX Y/C+RGB Same, plus Y/C+RGB
PM 5418TXS As PM 5418TX plus PDC/VPS and Closed Caption
PM 5418TXS Y/C+RGB Same, plus Y/C+RGB
PM 5418TN As PM 5418TX plus PAL B, G, I NICAM
PM 5418TN Y/C+RGB Same, plus Y/C+RGB
PM 5418TNS As PM 5418TN plus PDC/VPS and Closed Caption
PM 5418TNS Y/C+RGB Same, plus Y/C+RGB
PM 5418TXI Y/C+RGB As PM 5418TX plus Universal Chroma, Y/C+RGB and IEEE-488.1
PM 5418TNSI Y/C+RGB As PM 5418TNS plus Universal chroma, Y/C+RGB and IEEE-488.1

Accessories

PM 9539/01 RF Cable and 300Ω Transformer
PM 9575 75Ω BNC-BNC Cable

Options

PM 9546 Universal Chroma Unit
PM 9553G Y/C + RGB Output
PM 9561G 19" Rack Mount

Note: All options must be installed by the Service department.

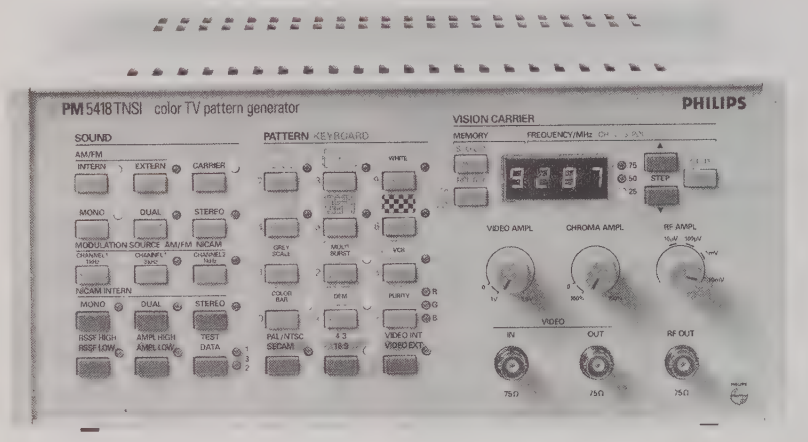
Customer Support Services

Also see Section 20.

Factory Warranty

One-year product warranty.

PM 5418 TXI & PM 5418 TNSI


PM 5418 TNSI color TV pattern generator
PHILIPS
SOUND
AM/FM
INTERN
EXTERN
CARRIER
MONO
DUAL
STEREO
MODULATION SOURCE AM/FM NICAM
NICAM INTERN
MONO
DUAL
STEREO
RSSF HIGH
RSSF LOW
AMPL HIGH
AMPL LOW
TEST DATA
PATTERN KEYBOARD
WHITE
GREY SCALE
MULTI BURST
VCR
COLOR BAR
DEM
PURITY
PAL/NTSC SECAM
4:3 16:9
VIDEO INT VIDEO EXT
VISION CARRIER
MEMORY
FREQUENCY/MHz
STEP
VIDEO AMPL
CHROMA AMPL
RF AMPL
VIDEO
IN
OUT
RF OUT
75Ω
75Ω
75Ω

PM 5418 TNSI

PM 5418 TXI & PM 5418 TNSI Remote-Controllable Multi-Standard Color TV Pattern Generator

- New features: 16:9 Aspect Ratio, PDC and Closed Caption
- Full GPIB remote control of sound and video modulation
- Covers all PAL, SECAM, and NTSC standards
- Over 100 test patterns instantly selectable
- Carrier frequencies selectable between 32 and 900 MHz
- Teletext, Antiope, Y/C + RGB and composite video outputs
- Stereo, dual-channel and mono sound reproduction
- NICAM digital sound reproduction (only PM 5418 TNSI)
- High-stability Xtal oscillators for production testing

The PM 5418 TXI & PM 5418 TNSI offer comprehensive color video pattern generation facilities covering all the world TV standards, making it an outstandingly versatile instrument for every TV and video service and testing application. These are the most complete models in the range of color video pattern generators, comprising the PM 5415 and PM 5418 families of instruments.

Both models cover the TV standards PAL, SECAM and NTSC, including the PAL M and N systems as used in Brazil and Argentina. Other facilities include Teletext, Antiope, Y/C+RGB and composite video outputs, and sound modulation in stereo, dual-channel and mono.

The PM 5418 TNSI offers additional NICAM digital sound, Closed Caption and PDC/VPS control for video cassette recorders.

The PM 5418 TXI & PM 5418 TNSI are fully remote-controllable via the standard GPIB/IEEE-488* adapter PM 9547G, so that it offers an ideal solution for use in automated testing systems. All the available TV and sound modulation standards can be selected remotely via the IEEE interface.

A choice of over 100 test patterns is available, and carrier frequencies between 32 and 900MHz can be selected by direct entry of the desired frequency at the numeric keyboard, or via the IEEE-488 interface. The repertoire of available test patterns also includes a number of special patterns, for example a 250kHz multiburst, a special VCR pattern and a demodulator pattern to meet the changing requirements for PAL, NTSC and SECAM reception.

The exceptionally comprehensive range of test facilities, together with full remote controllability, makes both versions a versatile general-purpose instrument for the testing and adjustment of multistandard TV sets, monitors and video recorders, in development, production and service environments.

The PM 5418 TXI & PM 5418 TNSI include an Y/C + RGB video output facility and the IEEE-488 adapter PM 9547G, allowing all functions (except the analog controls for RF, Video and Chroma amplitudes) of the instrument to be selected remotely via the IEEE/IEC bus. The 'bus learn mode' and 'identificatoin mode' are implemented in both versions.

Some of the technical data and test patterns of these versions are specially adapted to allow the alignment of multistandard CTV receivers.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

PM 5418 TXI & PM 5418 TNSI

Specifications

Chroma Section

PAL/NTSC			
TV systems	PAL NTSC	B,D,G,H,I,M,N M	
Subcarrier frequency	PAL B,D,G,H,I PAL M PAL N NTSC	4.433619 MHz 3.575611 MHz 3.582056 MHz 3.579545 MHz	coupled with line frequency acc. to system selected
- tolerance		2 p.p.m.	
- aging		2 p.p.m./year	
Subcarrier frequency - tolerance at	NTSC/4.43 23°C	4.433619 MHz <100 p.p.m.	not coupled with line frequency
Subcarrier blanking			acc. to system
SECAM			
TV system	SECAM	B,D,G,H,K,K1,L	
Subcarrier frequency		f_{OR} = 4.406250 MHz f_{OB} = 4.250000 MHz	coupled with line frequency
- tolerance		2 p.p.m.	
- aging		2 p.p.m./year	

Synchronization

Line and Field Synchronization			acc. to TV system, with interlacing; no interlacing with white crosshatch
	625 line systems	**525 line systems**	
Lines per field	625 624	525 524	white crosshatch
Line frequency	15625 Hz	15734.26 Hz	
- tolerance	<0.08 Hz	<0.08 Hz	
Field frequency	50 Hz	59.94 Hz	
Sync. Output Signal			BNC socket; combined signal with line and field synchronization pulses with amplitude difference
Impedance	6 kΩ		
Line pulse amplitude	2.6 ±0.3V		
Field line pulse amplitude	5 ±0.2V		
Polarity	Negative pulses		

Signal Content	B/W	Color	VCR	for Checking
Multiburst 1 full screen definition pattern of 8 vertical bars, 0.8 MHz to 4.8 MHz	●	●	●	video bandwidth amplitude response, resolution
Multiburst 2 250 kHz sine wave signal				
VCR Pattern (4 horizontal bars)				
a. one horizontal bar white 100% Y			●	white level
b. **Multiburst 1:** 8 vertical bars, 0.8 MHz to 4.8 MHz **Multiburst 2:** 250 kHz sine wave signal	●	●	●	amplitude response, resolution of VCR and other video recorders
c. Saturation step signal		●	●	linearity of chroma amplifier
8 steps of linear		●	●	sensitivity of chroma amplifier
decreasing chroma (R-Y)			●	color AGC
			●	ratio chroma/luminance writing current
d. moving white field			●	recording performance
in blackbar			●	slow/quick-motion
			●	still picture
DEM Pattern		●		PAL delay line; amplitude and phase error detection
a. PAL 4 horizontal bars bar 1 to 3 specially coded		●		PAL demodulators; subcarrier frequency phase (R-Y) - (B-Y)
bar 4: reference grey 50% Y (PAL M grey 54% Y)		●		G-Y-matrix PAL switch
b. NTSC 4 horizontal bars with NTSC burst; bars 1 to 4 specially coded		●		NTSC demodulators; subcarrier frequency phase of I and Q demodulator
bar 4 gives 'Venetian blind' effect		●		G-Y matrix
c. SECAM full screen Y = 50% R-Y = 0% B-Y = 50%				

Ordering Information

Models

PM 5418 TXI Color TV Pattern Generator
PM 5418 TNSI Color TV Pattern Generator

Included with Instrument

One-year product warranty, operating manual, line cord, spare fuse, PM 9547G IEEE adapter, PM 9538 RF cable 75Ω BNC - TV connector (DIN 45325).

Accessories

PM 9539 RF Cable with Impedance Transformer 75Ω to 300Ω BNC to TV Connector (DIN 45317)
PM 9575 Cable 75Ω BNC to BNC
PM 9561G 19" Rack Mount

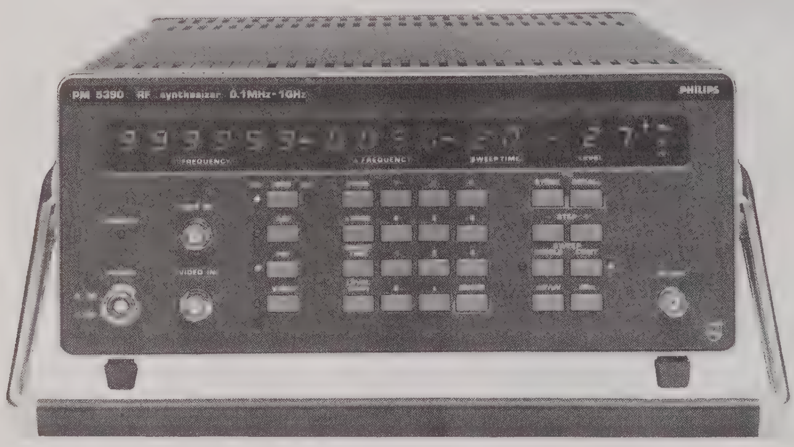
Customer Support Services

Also see Section 20.

Factory Warranty

One-year product warranty.

PM 5390 & PM 5390S



PM 5390

PM 5390 and PM 5390S Programmable RF Generators

- Frequency range 100 kHz to 1019.99 MHz
- Built-in GPIB/IEEE-488 interface
- Interval and external AM and FM
- Wide band AM video modulation (external)
- Internal and external sound subcarrier modulation both AM or FM
- Frequency sweep can be combined with AM or FM
- Frequency and amplitude stepping facilities
- Output levels from -127 dBm to -7 dBm (PM 5390) or to +13 dBm (PM 5390S)

The PM 5390 and PM 5390S, operating beyond 1 GHz, will find wide application in the generation of carrier and subcarrier frequencies for TV, radio and communications, in sensitivity tests and radiation measurements.

Sweep measurements on broadband amplifiers and IF filters, plus signal simulation such as gain/bandwidth and conversion loss or antenna gain, can easily be accommodated.

They will be of special interest for applications associated with cable TV bands, currently increasing UHF ranges and (ultimately) satellite TV.

The PM 5390 and PM 5390S are fully-programmable 1 GHz RF generators and provide AM, FM and video modulation, plus a wide range of sweep measurements and both automatic and manual frequency-stepping facilities. The output (100 kHz to 1020 MHz) is highly stable and accurate, and frequency, signal amplitude, frequency increment and sweep time can be digitally selected and displayed.

Careful Attention to Shielding

Particular care has been taken to ensure negligible RF interference. The RF circuitry is split into two separately shielded sections - oscillators in one part and the digital control circuitry in the other - to reduce any possible crosstalk.

As the accuracy of the output frequency is directly related to that of the crystal-controlled reference oscillator, this is contained in a specially shielded compartment in the control box. The circuitry is designed to ensure stability of better than 1 part in 10^{-6}.

Modulation

Internal and external AM and FM modulation are important features. AM modulation is effective over the full 1 GHz range, FM modulation is up to 340 MHz.

Video modulation facilities are possible over the full video band with the choice of internal or external AM or FM sound. This makes the instrument an valuable tool in, for example, video equipment production testing.

Internal or External Sweep

Single and continuous sweep modes can both be internally or externally controlled; sweep time can be varied from 0.05 to 20 seconds. Manual or automatic incremental frequency-changing is also provided in the range 1 kHz to 50 MHz, positive or negative. This latter facility is ideal for random sequence testing of TV and/or radio channels.

Extremely Wide Application Potential

The PM 5390 and PM 5390S are designed to cater for almost every possible application in industrial electronics including video and communications. As such, they meet today's need for a versatile, easy-to-use RF signal source having the most comprehensive modulation facilities; with reserve performance for tomorrow's needs.

Specifications

Technical Specifications

Frequency

Frequency Range: 100 kHz to 1019.99 MHz
Setting: Keyboard, IEEE/IEC bus
Display: 6-digits LED display
Resolution: 0.1-1000 MHz - 1 kHz; ≥1 GHz - 10 kHz
Setting Error: after 30 min. $\leq -3 \times 10^{-6}$; after 80 min. $\leq -1 \times 10^{-6}$

Reference Oscillator
Temperature Effect: $\leq 1 \times 10^{-6}$/K
Crystal Aging: $\leq 1 \times 10^{-6}$/month

Spectral Purity

	Output level	PM 5390	PM 5390S
Harmonics	≤-7 dBm	<-30 dB (-35 dB typ.)	<-30 dB (-35 dB typ.)
	to 0 dBm		-30 dB
	to + 7 dBm		<-25 dB
	to + 13 dBm		-20 dB

Non-Harmonics: <340 MHz: <-30 dB
≥340 MHz: <-40 dB (<-45 dB typ.)
Residual FM: ≤100 Hz (75 Hz typ.) (0.3 to 3 kHz)
SSB Phase Noise: -100 dBc/Hz (20 kHz offset at 100 MHz)
Residual AM: <0.5% typ. (10 Hz - 200 kHz)

Frequency Increment (Δ FREQUENCY)

Frequency Range: 100 kHz to 1019.99 MHz
Increment Range I: 1 kHz to 9.999 MHz resolution - 1 kHz
Increment Range II: 10.00 to 99.99 MHz resolution - 10 kHz
Setting: Keyboard, IEEE/IEC bus
Settling Time per Increment: 80 ms to 240 ms
Indication: 4 digits, LED

PM 5390 & PM 5390S

Output Characteristics

RF Output
Impedance: 50Ω
Output Level (into 50Ω): PM 5390: -127 dBm to -7 dBm; PM 5390S: -127 dBm to +13 dBm
Output Voltage rms (into 50Ω): 0.1 µV to 100 mV (PM 5390); 0.1 µV to 1V (PM 5390S)
Setting: Keyboard, IEEE/IEC bus
Display: $2^{1}/_{2}$ digits, LED
Dimension: dBm, µV, mV, V
Resolution: 1 dB
Connection: RF out front panel BNC connector
Load: Short-circuit proof
Maximum External Voltage: ±3.5V

Error:	PM 5390	PM 5390S	Output Level
Setting Error incl. Frequency Response:	±2 dB		-7 dBm
		±2 dB	<680 MHz +13 dBm
		±3 dB	>680 MHz +13 dBm
Attenuation Error per 1 dB Step	±0.3 dB	±0.3 dB	
- Additional	±0.3 dB	±0.3 dB	<680 MHz
	±0.5 dB	±0.5 dB	>680 MHz transitions -6 to -7 dB and each -10 dB further

Modulation

Amplitude Modulation, AM: 100 kHz to 1019.99 MHz
Frequency Modulation, FM: <340 MHz
Video without Sound Carrier: >30 MHz
Video Sound Carrier AM int/ext.: >30 MHz
Video Sound Carrier FM int/ext.: >30 MHz

Amplitude Modulation, Internal
Modulated Frequency Range: 100 kHz to 1019.99 MHz, RF level reduced by 6 dB
Modulation Frequency: 1 kHz, sine wave
Modulation Depth: 30%
Accuracy: ≤5%
Setting: Keyboard, GPIB/IEEE-488/IEC bus
Indication: LEDs

Amplitude Modulation, External
Modulated Frequency Range: 100 kHz to 1019.99 MHz, RF level reduced by 6 dB
Modulation Frequency: 20 Hz to 20 kHz
Modulation Depth: 0-≥80%
Modulation Coefficient: 10 mV p-p/%
Connection: BNC socket MOD in front panel
Input Impedance: 10 kΩ
Maximum External Voltage: ±5V
Setting: Keyboard, GPIB/IEEE-488/IEC bus
Indication: LEDs

Frequency Modulation, Internal
Modulated Frequency Range: 100 kHz to 339.999 MHz
Modulation Frequency: 1 kHz, sine wave
Deviation: ±25 kHz

Frequency Modulation, External
Bandwidth: 20 Hz to 100 kHz
Max. Deviation: ±80 kHz (5 to 339.999 MHz); ≤± 10 kHz (0.1 MHz-<5 MHz)
Modulation Coefficient: 100 mV/7.5 kHz
Connection: BNC socket MOD in front panel
Input Impedance: 10 kΩ
Maximum External Voltage: ±5V
Setting: Keyboard, GPIB/IEEE-488/IEC bus
Indication: LEDs

Video

Modulated Frequency Range: 30 MHz to 1019.99 MHz
Bandwidth: 8 MHz
Amplitude ext. CVBS-Signal: 1V p-p into 75Ω polarity: negative sync. signal; modulation: negative (or positive selectable by soldering links)
Residual RF Carrier: 15%
Connection: BNC socket video input front panel
Input Impedance: 75Ω
Maximum External Voltage: ±5V
Setting: Keyboard, GPIB/IEEE-488/IEC bus
Indication: LED

Sound

Sound Subcarrier Internal
Spacing of Vision/Sound Carrier: 5.5 MHz (4.5; 6; 6.5 MHz selectable by soldering links)
Tolerance: <0.2%
Vision/Sound Carrier Ratio: 13 dB
Type of Modulation: FM or AM

Internal Sound Subcarrier Modulation
Modulation Frequency: 1 kHz, sine wave
Deviation: ±40 kHz FM mode
Modulation Depth: 30% AM mode
Setting: Keyboard, GPIB/IEEE-488/IEC bus
Indication: LEDs

External Sound Subcarrier Modulation
Bandwidth: 50 Hz to 20 kHz
Pre-Emphasis: 50 µs
Modulation Coefficient FM: 100 mV p-p/8 kHz
Maximum Deviation: ±75 kHz
Modulation Coefficient AM: 100 mV p-p/6%
Maximum Modulation Depth: 50%
Connection: BNC socket MOD in front panel
Input Impedance: 0.5 MΩ
Maximum External Voltage: ±5V
Setting: Keyboard, GPIB/IEEE-488/IEC bus
Indication: LEDs

Frequency Sweep

Within a selectable sweep time the frequency passes through a selectable range Δ FREQUENCY in 50 steps from the start frequency (FREQUENCY) to the stop frequency (FREQUENCY + Δ FREQUENCY)
During fly-back the amplitude is reduced.
Frequency Range: 100 kHz to 1019.99 MHz
subrange I: 0.1 MHz to 169.999 MHz
subrange II: 170 MHz to 339.999 MHz
subrange III: 340 MHz to 509.999 MHz
subrange IV: 510 MHz to 679.999 MHz
subrange V: 680 MHz to 849.999 MHz
subrange VI: 850 MHz to 1019.99 MHz
Sweep Width: 50 kHz to 50 MHz
Step Width: 1 kHz to 1 MHz
Number of Frequency Increments per Sweep: 50
Setting: Keyboard, GPIB/IEEE-488/IEC bus
Indication: 4 digits

Sweep Modes

Single Sweep: Indication - LED
Continuous Sweep: Indication - LED
Sweep Time: 50 ms to 20s
Resolution: 0.01s to 1s
Setting: Keyboard, GPIB/IEEE-488/IEC bus
Indication: 2 digits, LED
Flyback Time Output Sweep Voltage: 200 ms

Sweep Time Out

BNC socket at the rear side increasing ramp during sweep time 0 to +500 mV (^ fstart to fstop)
Amplitude: 50 steps of 10 mV each
Impedance: 10 kΩ
Maximum External Voltage: ±10V

Storage of Parameter Setting

Memory Locations: 8 complete parameter settings
Storage: Buttons STORE 1 to 8
Store Time: min. 10 days
Battery: NiCd-cell
Setting: Keyboard, GPIB/IEEE-488/IEC bus

Remote Control

Conformity: IEEE 488/IEC 625
Connection: 24-pole GPIB/IEEE-488 bus standard interface
Device Address: Address switch rear side
Remote Indication: LED, remote, front panel
Interface Functions:
AH1 acceptor handshake capabilities
L2 Listener only
RL2 Remote/Local capability
DC1 Device clear capability
Control Functions: Fully remote controllable

PM 5390 & PM 5390S

Settling Time

Interface Reaction Time: 2 ms to 20 ms typical 5 msec

Frequency Settling Time: 15 ms to 120 ms

Level Settling Time: 5 ms

General Specifications

Power Requirements

Reference Value: 220V

Nominal Values: 110V/128V/220V/238V, selectable by wiring

Operating Limits: ±10% of selected nominal value

Nominal Frequency Range: 50/60 Hz, tolerance: ±5%

Power Consumption: 44W/53W

Environmental Capabilities

Ambient Temperature:

Reference Value: +23°C ±1K

Nominal Working Range: +5°C to +40°C

Limits for Storage and Transport: -40°C to +70°C

Cabinet

Protection Type (see DIN 40050): IP 20

Protection Class (see IEC 348): Class I, protective conductor

Mechanical Data

Size: 310 mm W x 140 mm H x 430 mm L (12.2 in W x 5.5 in H x 17 in L)

Weight: 9.9 kg (22 lb)

Ordering Information

Models

PM 5390* Programmable RF Generator 1 GHz

PM 5390S* Programmable RF Generator 1 GHz

**Available in European countries only*

Included with Instrument

One-year product warranty, operating manual, programming card, and line cord.

Accessories (Also see Section 19)

PM 9075 Coaxial Cable BNC-BNC

PM 9585/01 50Ω Termination, 1W

PM 2295/05 GPIB/IEEE-488 Cable (0.5m)

PM 2295/10 GPIB/IEEE-488 Bus Cable (1m)

PM 2295/20 GPIB/IEEE-488 Bus Cable (2m)

PM 9560 19" Rack Mount Adapter

Manual

PM 5390 Operator*

**No charge with purchase of unit*

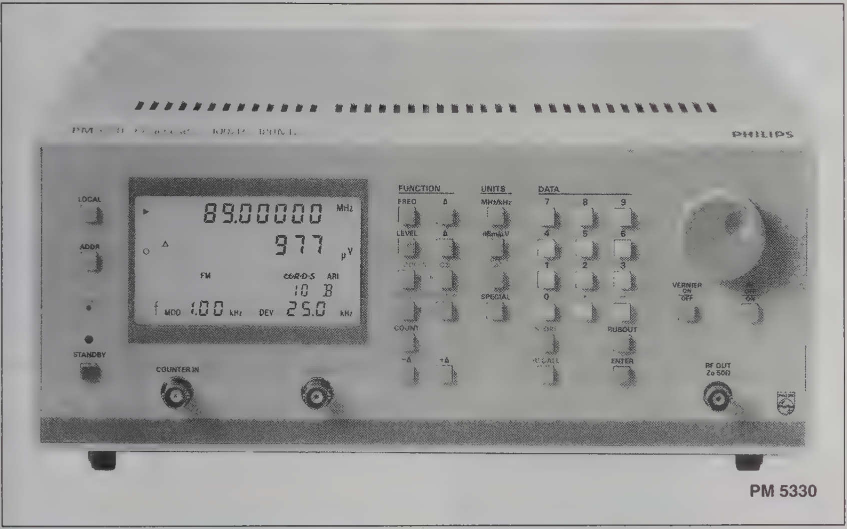
Customer Support Services

Also see Section 20.

Factory Warranty

One-year product warranty.

PM 5330


PM 5330

PM 5330 180 MHz Synthesized RF Generator*

- Frequency range 100 kHz to 180 MHz with a resolution of 10 Hz
- Output level -127 dBm to +13 dBm with a resolution of 0.1 dB
- All modulation facilities for AM, FM, FM-Stereo plus RDS and ARI
- RDS code generator with ARI (option)
- Variable frequency sweep facilities
- Memory for up to 75 complete instrument settings
- GPIB/IEEE-488 or RS-232 interface options
- Built-in 200 MHz frequency counter

The Integrated Solution for RF/IF and RDS/ARI Testing

The PM 5330 meets a wide range of testing requirements in the RF and IF frequency ranges up to 180 MHz, with the ability to handle high-level test and maintenance of circuits, products and systems targeted at both the professional and consumer markets.

Comprehensive, All-in-One Test Facilities

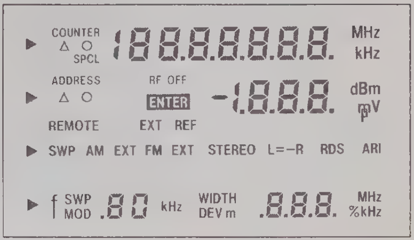
This generator stands out through its comprehensive, all-in-one test facilities that meet both general-purpose and specialist demands. The wide-ranging frequency and output levels, plus an extensive choice of modulation facilities, make the advanced PM 5330 ideal for testing, alignment and troubleshooting of RF components, radio receivers, consumer audio, communication and paging equipment.

An optional high-frequency crystal oscillator offers extended high-stability performance, with very low drift and aging specifications, extending the PM 5330's capabilities further into the fields of professional and military telecommunication equipment.

Next to these high-level testing, maintenance and quality-control capabilities, the PM 5330 has the easy operation and versatility that make it ideal for use in technical education and training.

Plus Dedicated Facilities for RDS/ARI Testing

The PM 5330 combines its all-around RF/IF capabilities with specific facilities for testing the latest generation of high-end consumer radio equipment incorporating RDS (Radio Data System) and ARI (Automotive Radio Information) functions. Normally these test capabilities are provided only by dedicated test instruments costing much more than the PM 5330, and lacking the PM 5330's all-in-one RF/IF test capabilities.



Completing the PM 5330's versatility in the area of consumer audio equipment testing, an optional FM-Stereo modulation mode is also available, providing both stereo multiplex and RF modulated signals.

Built-in 200 MHz Counter

Increasing versatility still further, the PM 5330 has a built-in 200 MHz counter that gives you additional functionality. The counter covers a 10 Hz to 200 MHz frequency range, with a frequency read-out of up to 5 digits.

Easy Operation with Clear LCD Display

Making the PM 5330 exceptionally easy to operate, the large backlit LCD display shows all parameter and function settings at-a-glance.

Entry of parameters can be done in a number of ways, to meet your own preferred working method and application requirements:

- Direct value entry at the numeric keypad;
- Changing an existing display value using the rotary control, together with the digit select function to give the desired resolution;
- Changing an existing display value with the Up/Down step adjustment, with variable increment sizes, as small as 10 Hz for frequency and 0.1 dB for levels.

Thanks to these options you can choose the most convenient method of operation for every situation: entry of precise parameter values at the keypad, manual scanning through a wide frequency spectrum, or making minor adjustments at the resolution and speed of your choice.

GPIB/IEEE-488 or RS-232 Interfaces

The PM 5330 can conveniently be used in automated test set-ups, thanks to the optional RS-232 or GPIB/IEEE-488* interfaces. The IEEE-488 interface allows the PM 5330 to be integrated into GPIB test systems. While for "stand-alone" automation, the RS-232 interface provides a cost-effective solution through which the PM 5330 can be connected to a PC which provides both remote control and data-collection facilities.

Both interfaces enable full remote programmability of the PM 5330, plus facilities for download-

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** Available in European Countries only*

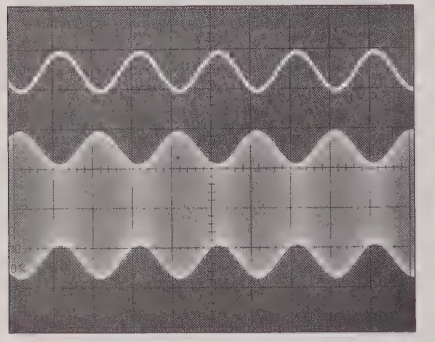
**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

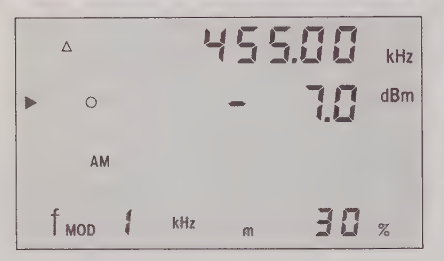
ing of user-defined test set-ups and routines, with the PC-based RDS-MessageWriter software package.

All-in-One Modulation Facilities

A wide range of modulation facilities gives the PM 5330 exceptional versatility for many test applications. Available modulation modes at AM, FM and Sweep as standard, with optional FM-Stereo and RDS/ARI facilities.

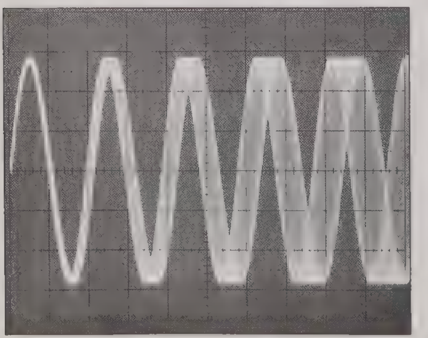
AM

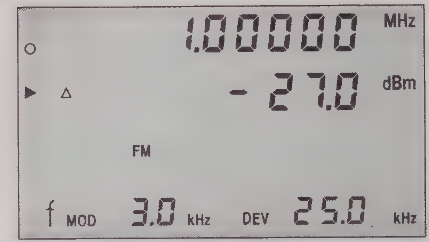




The internal AM modulation frequency is programmable between 20 Hz and 20 kHz, with a maximum resolution of 10 Hz. The modulation depth is selectable between 0 and 99.9%, with a resolution of 0.1%. Modulation may also be from an external source, and if required can be combined with internal or external FM modulation

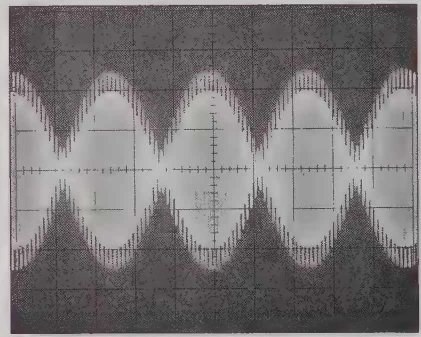
FM

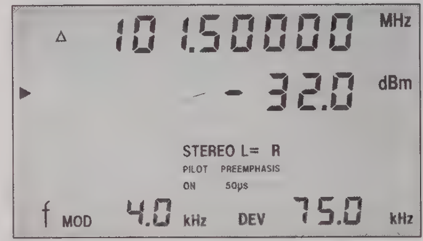




The internal FM modulation frequency is programmable between 20 Hz and 20 kHz. The deviation is selectable from 0.1 kHz up to 100 kHz, with a resolution of 0.1 kHz. For external modulation, the Fmod range is 20 Hz to 75 kHz, with a maximum deviation of 100 kHz.

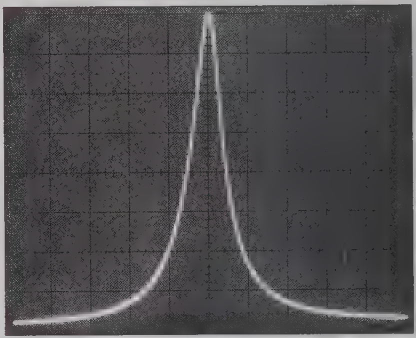
FM-Stereo

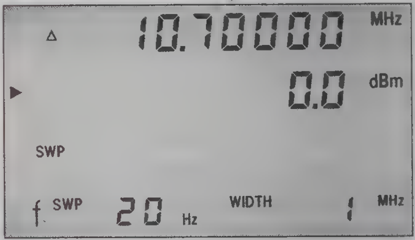




The FM-Stereo option provides both the stereo multiplex signal and RF-modulated signals. The FM Stereo mode allows both internal and external modulation across the frequency range 20 Hz to 15 kHz. Pre-emphasis is selectable between 0µs, 50 µs and 75 µs. A choice of full stereo (L+R), left channel only or right channel only is available. The pilot tone can be switched off if required.

Sweep





The sweep function allows checking high, low and bandpass filters, attenuators etc. Ten calibrated sweep widths from 10 kHz to 10 MHz are available. The center frequency is clearly indicated by a dot marker. Thanks to the linearity of the sweep signal, all parts of the bandpass curve can be shown with high accuracy. The lower sweep width of 10 kHz and slow sweep speeds are ideal for narrow bandpass testing such as in SSB applications.

Integrated RDS/ARI Test Capabilities

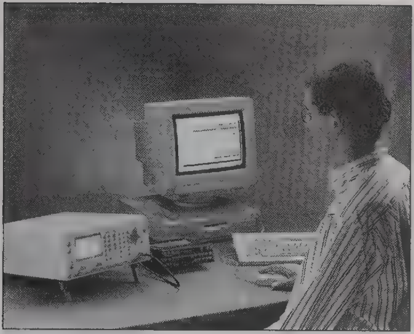
Optional facilities for RDS/ARI and FM-Stereo testing take the economic PM 5330 into a functionality area that was formerly available only through costly, dedicated test equipment.

RDS/ARI Option

This optional module adds the test capabilities needed for maintenance and quality control on a wide range of high-end consumer radio sets, including domestic receivers and tuners and car audio equipment.

The increasingly important RDS function automatically keeps a selected station correctly tuned as the receiver location changes, while also offering features like program and station information display and automatic recognition of Traffic Program announcements.

PM 5330



The RDS/ARI option provides convenient and fully integrated test facilities in check the RDS and ARI performance of RDS decoders. The ten most commonly used RDS data records are available as predefined messages. They can be selected either at the front panel or by remote control, allowing the PM 5330 to be used either as a stand-alone benchtop instrument or integrated in an automatic test system.

RDS-MessageWriter

Up to ten further RDS messages are freely programmable. User-define data records can be downloaded from a PC into the PM 5330's internal non-volatile memory. Programming of test routines is made easy by the optional RDS-MessageWriter, which allows an often complex and time-consuming task to be completed easily in just a few minutes.

As well as handling routine performance checks, phase errors in RDS decoders can be simulated by deliberate phase adjustment of the test signals.

Specifications

Technical Specifications

Specifications apply with outputs terminated with 50Ω impedance. Stated tolerances apply after a warming-up time of 30 minutes and a recalibration interval of 12 months.

RF Signal Characteristics

Frequency

Range: 100.00 kHz to 179.99900 MHz
Resolution: 10 Hz
Accuracy & Stability: As reference oscillator

Internal Reference

Version:	Standard	Optional
Type:	Unstabilized	Over stabilized
Frequency:	10 MHz	10 MHz
Stability Vs Temp. (5°C to 40°C):	3 x10^{-6}	5x10^{-8}
Aging/Year:	1x10^{-6}	1x10^{-7}
/Month:	n/a	3 x 10^{-8}
/24 Hours:	n/a	1x10^{-9} 1)

Internal Reference Output: Approx 220 mV rms, 50Ω, BNC, rear panel

External Reference Input

Input Frequency: 1, 2, 5, or 10 MHz
Input Level: 75 mV rms to 1.4V rms into 50Ω load

RF Output

Level Range: -127.0 dBm to +13.0 dBm (0.1 μV to 1V rms)
Resolution: 0.1 dB
Absolute Level Accuracy: ±1.5 dB
Flatness: ±0.5 dB
Impedance: 50Ω nominal
Source VSWR: 1.4 at ≤3 dBm, 1.8 at >3 dBm
Unit Display Selection: μV, mV, dBm, dB mV and dB μV
Reverse Power Protection:
15W RF; at ≤-7 dBm settings
30W RF; at ≥-7 dBm settings
50W RF; at ≥3 dBm settings
±10V DC; at any setting
RF Output ON/OFF Switch: Can be manually and remotely controlled. Is automatically activated when RPP value is exceeded.
Level with RF OFF: <-127 dBm (0.1 μV rms)
Connector: BNC, front panel

Spectral Purity (CW mode and maximum Output Level)

Harmonics: -40 dBc
Non Harmonics: -52 dBc at 100 MHz and ≥15 kHz offset
Residual FM: <10 Hz rms; (0.3 to 3 kHz bandwidth CCITT)
Residual AM: 0.1%; (0.03 to 20 kHz bandwidth)
SSB Phase Noise: <-105 dBc/Hz; at 20 kHz offset from carrier

Modulation

Modes

Modulation Modes: AM, FM, Sweep, FM-Stereo (optional); RDS and ARI (optional)

Modulation Sources

AM and FM: Internal Audio generator and/or external modulation input: BNC/ front panel/ 10 kΩ input impedance
Sweep: Internal sweep generator
FM-Stereo: Internal Audio generator and/or external FM-Stereo modulation inputs/rear panel
RDS/ARI: Internal RDS code generator

Audio Generator (Internal Modulation Sources)

Frequency Range: 20 Hz to 20 kHz, sine wave
Resolution fmod: 10 Hz: (20 Hz to 1.99 kHz); 100 Hz: (2 kHz to 20.0 kHz)
Accuracy: 3%
Internal Audio Output: BNC, rear panel
Output Amplitude: 1V p-p
Distortion: <0.03% at fmod >50 Hz
Output Impedance: 1 kΩ

AM Internal

Modulation Source: Internal audio generator
Depth m: 0% to 99.9% in 0.1% steps
Accuracy at m = 0-90%:
5% of m; at f mod = 1 kHz;
10% of m; at fmod = 20 Hz to 20 kHz
Distortion at m= 30%: <0.5% fmod = 1 kHz

AM External

Modulation Source: External modulation input
AM Bandwidth (-1 dB): 20 Hz to 20 kHz
Depth: 0 to .99%
Modulation Sensitivity: 1% depth/10 mV p-p input
Distortion at m = 30%: <0.5% fmod ≤10 kHz; <0.8% fmod >10 kHz

FM Internal

Modulation Source: Internal audio generator
Deviation:
±0.1 kHz to 75.0 kHz; (fmod <30 Hz)
±0.1 kHz to 100 kHz; (fmod >30 Hz)
Accuracy: 3 kHz, 1 kHz typical at fmod = 1 kHz and Dev = ±0 to 75 kHz
Distortion at Dev ± 25 kHz: <0.1% THD; at fmod = 1 kHz

FM External

Modulation Source: External modulation input
FM Bandwidth (-1 dB): 40 Hz to 75 kHz
Deviation: ±0 to 100 kHz at fmod >30 Hz
Modulation Sensitivity: 7.5 kHz/100 mV p-p
FM Distortion at Dev ±25 kHz: <0.1%% THD: (0.2 kHz to 10 kHz); <0.2% THD; (10 kHz to 20 kHz)

Sweep

Sweep Center Frequency: 100.00 kHz to 179.99900 MHz
Sweep Width: 10 kHz-10 MHz, in 10 calibrated ranges (1, 2, 5 steps)
Sweep Frequency: 2, 5, 10, 20 and 50 Hz
Sweep Output: -5V to +5V triangle into 1 kΩ, with sweep interrupts at 0V for X-axis marker indication
Marker Indication: Bright spot at center frequency in X-Y mode

FM-Stereo (Optional)

FM-Stereo Internal

Modulation Source: Internal audio generator
Modulation Modes: L(R=0), R(L=0), L=R and L = -R, pilot only
Modulation Frequency: 20 Hz to 15 kHz
Pre-Emphasis: 0, 50 and 75 μs selectable

FM-Stereo External

Modulation Source: External FM-Stereo modulation inputs
Modulation Mode: L&R, separately externally controllable
Input Connectors: 2 x BNC, rear panel
Impedance: 1 MΩ
Bandwidth (-1 dB): 40 Hz to 15 kHz
Modulation Sensitivity: 9.2 kHz/V at 400 Hz
Pre-Emphasis: 0, 50, 75 μs selectable

FM-Stereo Multiplex Signal

Channel Separation: ≥46 dB; at 100 Hz to 5 kHz
M/S Separation: ≥45 dB; at 40 Hz to 5 kHz
Distortion: <0.2% THD; at 1 kHz
S/N Ratio: <-60 dB; rel to =+6 dBm at 500 Hz (DIN 45405 and CCIR 468-2)
Output: BNC rear panel

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1) After 30 days of continuous operation

PM 5330

RF Modulation with FM Multiplex Signal[2]

Modulation Source: FM-Stereo multiplex signal
Deviation: ±(0.1 kHz to 100 kHz) at fmod >30 Hz for L=R, L=-R; ±(0.1 kHz to 50 kHz) at fmod >30 Hz for R, L
Resolution: 0.1 kHz
Accuracy: 3 kHz (20 Hz to 15 kHz), 1 kHz typical; at fmod = 1 kHz and 0 to 75 kHz dev
Distortion: 0.2% THD at fmod = 1 kHz and 25 kHz dev
S/N Ratio Unweighed: 52 dB; Mono/Stereo (DIN 45405)
S/N Ratio Weighed: 53 dB; Mono/Stereo (CCIR 468-1)

Pilot Signal Output

Frequency: 19 kHz ±2 Hz square wave
Output Level: 1V
Impedance: 200Ω
Output: BNC rear panel

RDS (Optional)

RDS Sub-Carrier

Sub-Carrier Frequency: 57 kHz ±6 Hz
Phase Rel to Stereo Pilot: 90° or 0°, selectable
Suppression Sub-Carrier: >60 dB

RDS Data

Coding: Differential and bi-phase coding
Channel Spectrum Shaping: Cosine filter, H_T (f) = cos(π-f-fd/4)
Total Number of Records: 20
Predefined Records: 10
Programmable Records: Up to 10 by down loading from IBM compatible PC
Records Length: Max. 128 groups/record
Sequence of Groups: Fixed, for predefined records; Free programmable, for programmable records
Number of AF: Max 25 alternative frequencies group types Version A and max 12 of group types Version B

RDS Data Definitions

Tuning Information: PI, PS, PTY, TP EON and AF
Switching Information: TA, DI, MS and PIN
Test Information: RT
Additional Information: IH

Front Panel Control Capabilities

RDS Coder: On/Off
ARI Coder: On/Off
Records 1 to 10: Selectable (pre-defined)
Records 11 to 20: Selectable (self-programmed)

Remote Control Capability

Up to 10 complete RDS records can be customer defined and down-loaded with menu driven PC program. All RDS front panel selections are remote controllable. Interfacing via optional RS-232 interface PM 9549 or IEEE-488 interface PM 9548.

ARI Signal (Optional) (According to EBU and USA standards)

Transmitter Identification Code SK

Sub-Carrier Frequency: 57 kHz ±6 Hz
Phase Rel to Stereo Pilot: 0°

Area Signal BK (EBU)

Modulation Codes: A, B, C, D, E, F
AM Depth: m = 60%

Area Signal ZO (USA)

Modulation Codes: 1 through 10
AM Depth: m = 60% (ME off), m= 30% (ME on)

Announcement Signal DK (EBU)

Modulation Frequency: 125 Hz
AM Depth: 30%

Message Signal DK (EBU)

Modulation Frequency: 142,5 Hz (ME 1); 154.9 Hz (ME 2)
AM Depth: 60%

Synchronization of RDS/ARI Sub-Carrier

Frequency: Stereo pilot, with FM-Stereo option installed; X-tal, without FM-Stereo option installed
Phase: 90° ±3°
Phase Offset: -10°, no off-set, +10° selectable

RDS/ARI Signal Output

Connector: BNC, rear panel
Impedance: <12Ω
Level into 300Ω ARI; Unmodulated Carrier: -14 dBm (155 mV rms)
RDS Initial: -24.5 dBM adjustable; -32.2 dBm to -14 dBm, in combination with FM deviation

RF Modulation from RDS Signal

Frequency Deviation
Initial: ±1.25 kHz
Programmable: ±0.7 to 4 kHz in combination with RDS signal

RF Modulation from ARI Signal

Frequency Deviation: ±3.75 kHz-0% to +10% at unmodulated sub-carrier

Front Panel Control Capability

ARI Coder: On/Off
Transmitter Code: SK
Area Code Bk with Ranges: A, B, C, D, E and F selectable
Announcement Code: DK
USA Zone Code: 1 to 10
Message Code: ME 1, ME 2

Counter

Frequency Range: 10 Hz to 200 MHz
Input Voltage: 15 mV rms to 5V rms sine
Resolution: 10 Hz, at fc ≤1 MHz; 100 Hz at fc ≤10 MHz; 1 kHz at fc >10 MHz
Input Impedance: Selectable 1 MΩ//45 pF and 50Ω
Input Connector: BNC, front panel

User Interface

Display: Backlit LCD with indication of selected functions and set parameters
Parameter Data Entry:

- Keypad, to enter complete new values
- Rotary knob, to change existing display values, with digit-select resolution
- Up/Down keys, to modify existing display value with selectable increments. Min increment: 10 Hz for frequencies, 0.1 dB for levels

Stored Settings: 75 complete control settings can be stored and recalled from internal non-volatile memory.
Power-On Setting: As latest power-off setting

IEEE-488 Bus Interface (Option PM 9548)

Compatibility: IEEE-488.2 - 1987
Interface Functions: AH1, SH1, LA, T6, RL 1, SR1, DC1
Programmable Function: All
Isolation: In-outputs galvanically separated with opto-couplers
Response/Settling Time: 20 to 400 ms for incremental frequency change within range 20 ms for incremental amplitude change within range

RS-232 Interface (Option PM 9549)

Command Set: Fully compatible with IEEE-488.2 -1987
Baud Rate: 1200-19200
Data Bits: 7 or 8
Stop Bits: 1 or 2
Parity: Odd, even or no parity check
Isolation: In-outputs galvanically separated with opto-couplers

General Specifications

Power Requirements: Selectable 100V, 120V, 220V and 240V ±10%; 47.5 to 63 Hz; 66W with all options installed
Safety: Complies with IEC 348 class I and CSA 22.2 No 231
Operating Temperature: 5°C to 45°C
Storage Temperature: -40°C to +70°C

Humidity

Operating: 20% to 80% RH
Non-Operating: 5% to 95% RH
Air Pressure/Altitude: 798 to 1064 hPa 2200m/7200ft (operating); 12000m/40000 ft (non-operating)
Vibration: 2G at 55 Hz according to MIL-T-28800D, Class 5, Style D
Shock: Half-sine 40G according to MIL-T-28800D, Class, Style D. Bench handling. Shipping container.
EMC: VDE 0871 Level B and V_{fg} 1046/84

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[2] *Data apply with modulation by internal audio generator*

PM 5330

Mechanical Data

Size: 140 mm H x 315 mm W x 425 mm D (55.1 in x H x 124 in W x 167.3 in D)
Weight: 13.5 kg (30 lbs) net

Ordering Information

The PM 5330* ordering number consists of the basic type number and a 3-digit suffix, specifying the required configuration and country version. The first and second suffix digits specify the options installed according to the table below. The IEEE-488 GPIB interface PM 9548 and the RS-232 interface PM 9549 are retrofittable and can therefore also be ordered separately for upgrading. The other options are only delivered factory installed. The third suffix digit defines the country version. The PM 5330 is delivered in accordance to local power requirements. If for re-export another line voltage setting and/or another power cord is required, please indicate this in the third suffix digit as indicated in the table.

**Available in European countries only*

Included with Instrument

One-year product warranty, line cord, operating manual, operating/programming card PM 9537, RF cable.

Accessories

PM 9074 50Ω BNC Cable
PM 9538 RF Cable BNC - B&L
PM 9548 IEEE-488 GPIB Interface
PM 9549 RS-232 Interface
PM 9558/10 RDS-MessageWriter
PM 9562 19" Rack Mount Adapter

	Options					
Version	**Basic Unit**	**PM 9548 IEEE-488**	**PM 9549 RS-232**	**High Stab X-tal**	**FM-Stereo**	**RDS/ARI**
PM 5330/00.	X					
/.2.	X	X				
/.3.	X		X			
/.4.	X			X		
/.6.	X	X		X		
/.7.	X		X	X		
/5..	X				X	
/8..	X					X
/9..	X				X	X
/..1	Universal European	220V/16A, 50 Hz				
/..4	United Kingdom	240V/13A, 50 Hz				
/..5	Switzerland	220V/10A, 50 Hz				
/..8	Australia	240V/10A, 50 Hz				

PM 6307

PM 6307 wow and flutter meter
PHILIPS
DRIFT
FLUTTER
SET ZERO
ZERO
kHz
FILTER
METER
3.15
3.00
ON
OFF
INT
EXT
NORM
SLOW
OFF

PM 6307

PM 6307 Wow & Flutter Meter

- Crystal controlled oscillator
- High accuracy and frequency stability
- 3150 Hz and 3000 Hz selectable
- Separate 'Drift' and 'Flutter' indication
- Input/Output DIN 41 524 connector

The wow and flutter meter is a must in audio and video service workshop. The compact, easy-to-use PM 6307 allows speed variations in audio and video tape recorders, record players and movie projectors to be identified and measured conveniently. Very accurace wow and flutter checks and alignments can be made. The crystal-controlled oscillator gives the choice of 3.15 kHz (DIN) or 3 kHz frequencies.

Speed fluctuations are indicated on two separate analog meters, one for drift and one for wow and flutter. Calibration of the drift indicator is done just by pressing the ZERO button, while the SET ZERO control is adjusted for zero indication. The crystal oscillator gives a short warm-up time, so the instrumet can be used immediately after switch-on. Pushbuttons allow simple selection of measuring ranges for drift and flutter switch. A SLOW RESPONSE setting allows extremely slow speed variations to be detected.

The PM 6307 is ideal for service use because it allows fast differentiation of mechanical and electrical problems. In general, the wow and flutter function indicates a mechanical fault, while the drift meter reveals electrical or electronic faults.

Specifications

Technical Specifications

Oscillator

Frequency: 3150 Hz and 3000 Hz, selectable (X-tal controlled)
Accuracy: $<10^{-4}$ (ref. 23°C)
Stability: 1×10^{-6}/K
Output 1: DIN connector at front panel (DIN 41 524)
Signal Voltage: 400 mV p-p Open circuit; 100 mV p-p at 47 kΩ load; 20 mV p-p at 10 kΩ load
Internal Resistance: 430 kΩ
Output 2: BNC connector at rear panel
Signal Voltage: 1V p-p
Output Impedance: 600Ω

Measurement Section

Input 1: Same as output 1 at front panel
Input 2: BNC connector at rear panel
Input Voltage: 2 mV to 10V
Input Impedance: 10 kΩ
Test Frequencies: 3150 Hz or 3000 Hz selectable
Calibration: With zero set push-button and control on front panel
Drift-Measuring Range: ±0.3%, ±1%, ±3%
Indication: Analog meter, with zero at midpoint
Flutter-Measurement Range: 0.1%, 0.3%, 1%, 3%
Indication: Analog meter

Frequency Response Flutter Indication

Selectable
A. weighted (filter on): according to DIN Standard 45 545
B. unweighted (filter off): 0.5 Hz to 500 Hz (-3 dB) bandpass
C. external: connector at rear panel for use of an external filter (filter ext.)

Reading Speed

Normal: According to DIN 45 507
Slow: Slow response (e.g. to measure the average value to fast speed variations)
Output 3: BNC connector (on rear panel)
Bandwidth: 0.5 Hz to 500 Hz (-3 dB) (For fast recording on oscilloscope display)
Output Impedance: 10 kΩ
Frequency Variation Coefficient: For 'Drift' 1V corresponds with 1%

Power Requirements

Line Voltage: 115V, 230V
Power Consumption: 2W
Line Frequency: 50/60 Hz
Size: 230 mm W x 110 mm H x 200 mm L (9 in W x 4.3 in H x 7.9 in L)
Weight: 2 kg (4.4 lb)

Ordering Information

Models

PM 6307* Wow and Flutter Meter

Included with Instrument
One-year product warranty, operating/service manual.

Accessories
Test Cassette 3150 Hz
Record 3150 Hz ($33^{1}/_{3}$ rpm)
Both items are to DIN 45 545

Manuals
PM 6307 Operator*
PM 6307 Service*
**No charge with purchase of unit*

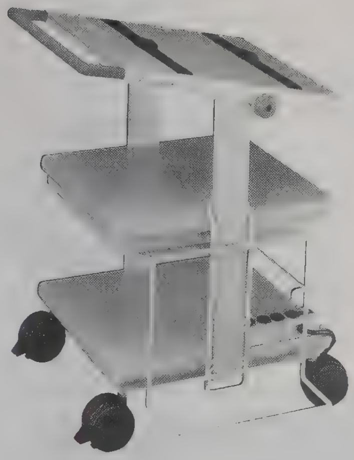
Customer Support Service

Also see Section 20.

Factory Warranty
One-year product warranty.
**Available in European countries only*

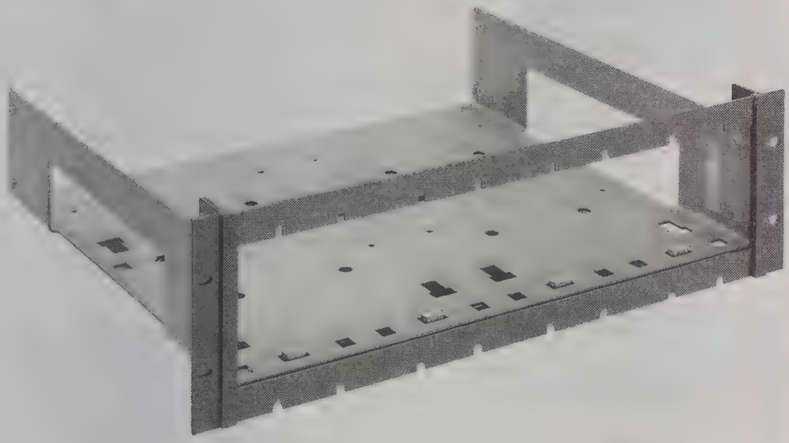
General Accessories

This section includes an assortment of general instrument accessories that are compatible with a wide variety of Fluke instruments and products. Also refer to the individual product sections in this catalog, as well as the alphabetical index, for specifications and ordering information on other accessories designed specifically for use with particular products.



Cart Page 386

Adapters Page 382

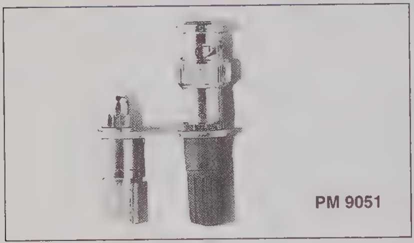


Rack Mounts Page 387

Cables Page 383

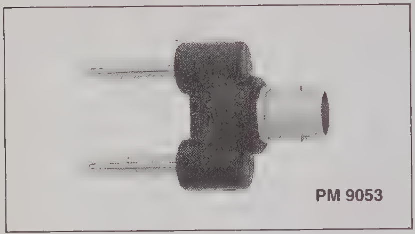
Adapters	Page 382
Cables	Page 383
Rack Mounts	Page 387

Accessories


PM 9051

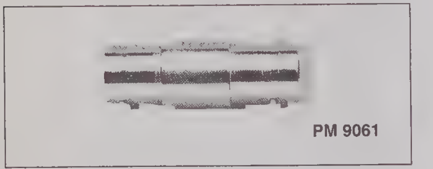
BNC - Banana Adapter

PM 9051 Adapter BNC (m), 4 mm Banana (f)


PM 9053

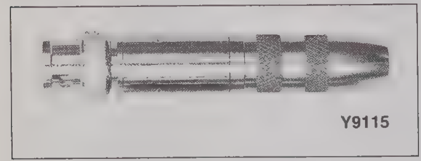
BNC - Banana Adapter

PM 9053 Adapter BNC (f), 4 mm Banana (m)


PM 9061

BNC - BNC Adapter

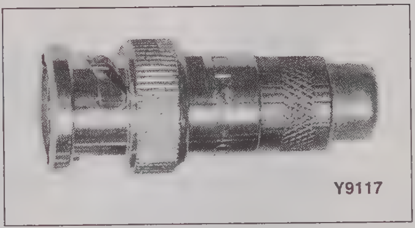
PM 9061 Adapter BNC (f) - Banana (f)


Y9115

Phone Adapters*

Adapters permit interconnection between equipment with phone plugs and equipment with BNC double banana plug connectors.

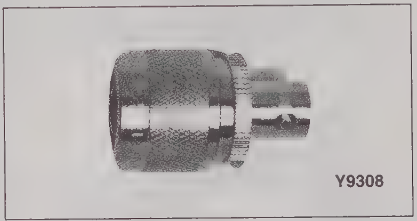
Y9115** Phone Jack to BNC Plug


Y9117

Phono Adapters*

Adapters allow interconnection between equipment having phono connectors and BNC connectors.

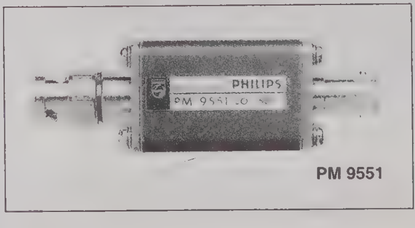
Y9117** Phono Jack to BNC Plug


Y9308

Between Series Coaxial Adapters

This accessorie provides an interface between one coaxial connector series and another.

Y9308 Adapter, Type N (m) to type BNC (f), 50Ω

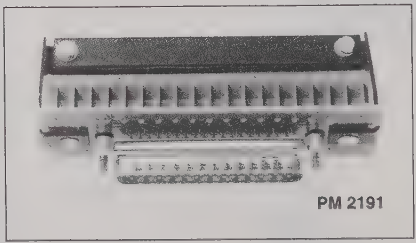


PM 9551

Adapter

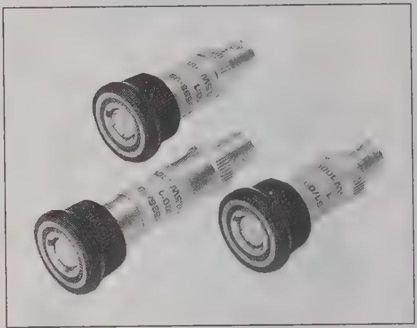
50Ω to 600Ω Adapter for all generators.

PM 9551 50Ω to 600Ω Adapter


PM 2191

Terminal Adapters

PM 2191/01 Terminal (qty. 3)
PM 2191/10 Terminal (qty. 1)

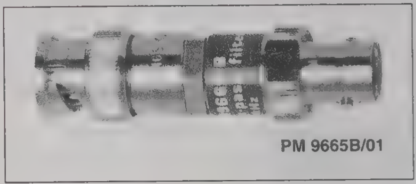


PM 9591/091 10:1 50Ω Attenuator
PM 9596/091 100:1 50Ω Attenuator
PM 9598/091 10:1 75Ω Attenuator
PM 9599/091 Set of 3 Attenuators

These products provide attenuation of wide bandwidth VHF signals, with proper termination of 50Ω and 75Ω cables respectively.

Each attenuator has BNC male female connectors and 50Ω output. On oscilloscopes so equipped, the scale factor readout and input impedances are automatically set.

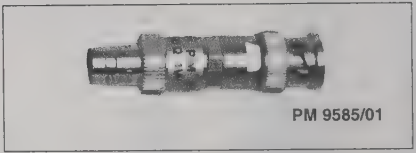
Attenuation: 10:1 for PM 9591/09 and PM 9598/09, 100:1 for PM 9596/09
Input Resistance: 50Ω for PM 9591/09 and PM 9596/09, 75Ω for PM 9598/09
Output Resistance: 50Ω
Maximum Input Voltage: 100V
Maximum Power Dissipation: 0.5W


PM 9665B/01

Low Pass Filter

For model PM 6662.

PM 9665B/01 50 kHz Low Pass Filter


PM 9585/01

Feedthrough Termination

BNC to BNC 1W feedthrough terminator.

DC Resistance: 50Ω ±1%
Max. VSWR: 1.1 from dc to 100 MHz, 1.2 from 100 to 250 MHz

PM 9585/01 50Ω Feedthrough Termination, 1W

** These adapters and exposed metal connectors should not be used for floating measurements that are greater than 30V ac, 42V peak or 60V dc above earth ground.*
***Available through Distributors*

PM 9581/01

Feedthrough Termination

BNC to BNC 3W feedthrough terminator.

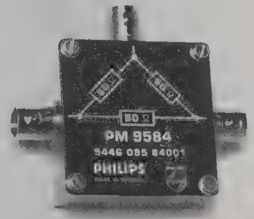
DC Resistance: 50Ω ±1%
Max. VSWR: 1.1 from dc to 100 MHz, 1.2 from 100 MHz to 250 MHz

PM 9581/01 50Ω Feedthrough Termination, 3W

PM 9067

T-Piece, BNC

PM 9067 T-piece, BNC (1x m, 2x f)



PM 9584

T-Piece

BNC to BNC matched power splitter.

Voltage Attenuation Ratio: 2x (both outputs terminated in 50Ω)
DC Resistance: 50Ω ±1% in each load arm
Maximum Input Power: 4W

PM 9584/02 50Ω T-Piece

Cables

PM 9074

BNC Coaxial Cables

Coaxial cables with BNC connectors (plugs) on each end.

PM 9074 BNC Coaxial Cable 50Ω 1m (3.28 ft)
PM 9075 BNC Coaxial Cable 75Ω 1m (3.28 ft)

PM 9071

Coaxial Cables

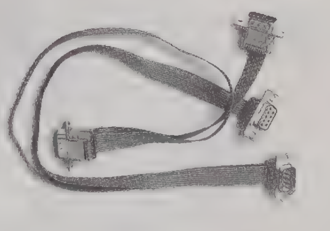
PM 9071 Banana to Banana Cable 135Ω, 1m (3.28 ft)
PM 9072 Banana to Banana Cable 135Ω, 1m(3.28 ft)

PM 9588/01

Coaxial Cable Set

Set of 15 pcs, 50Ω coaxial cables with BNC connectors (plugs) on each end. Length defined as delay time; 5 pcs x 1 ns, 4 pcs x 2 ns, 4 pcs x 3 ns, 3 pcs x 10 ns.

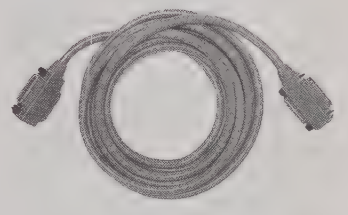
PM 9588/01 50Ω Coaxial Cable Set



PM 2192/01

Bus Extension Cable

PM 2192/01 Bus Extension Cable

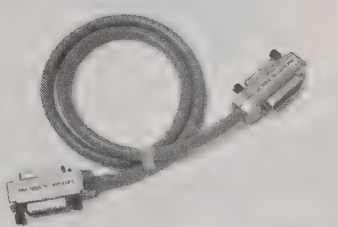


Y8022

IEEE-488-Compatible Cables

A series of cables in three lengths are used to connect instruments to each other and to the IEEE-488 Bus. Each cable end has both a plug and a jack and are shielded.

Y8021 Shielded IEEE-488 Cable 1m (3.28 ft)
Y8022 Shielded IEEE-488 Cable 2m (6.56 ft)
Y8023 Shielded IEEE-488 Cable 4m (13 ft)



PM 2295

GPIB-IEEE Cables†

PM 2295/05 Cable GPIB-IEEE, 0.5m (1.64 ft)
PM 2295/10 Cable GPIB-IEEE, 1m (3.28 ft)
PM 2295/20 Cable GPIB-IEEE, 2m (6.56 ft)

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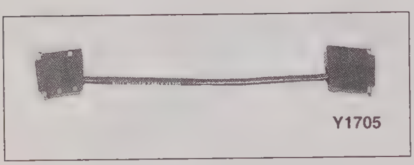
* *These adapters and exposed metal connectors should not be used for floating measurements that are greater than 30V ac, 42V peak or 60V dc above earth ground.*
***Available through Distributors*

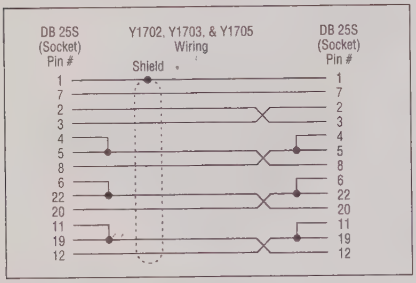
†Available in European countries only

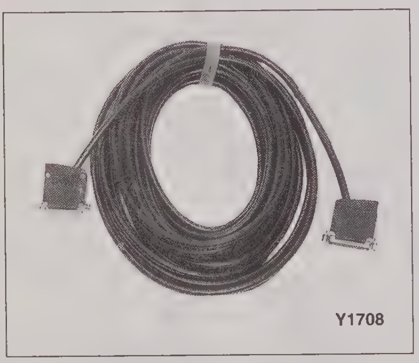


RS-232C Cables

These cables are to connect instrument controllers, terminals, modems, printers, etc. to other similar equipment compatible with EIA Standard RS-232C.

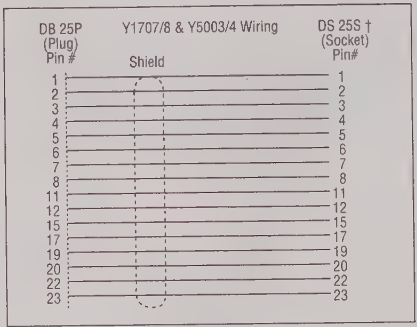
Y1702 Null Modem Cable 2m (6.56 ft)
Y1703 Null Modem Cable 4m (13 ft)
Y1705 Null Modem Cable 30 cm (1 ft)


DB 25S (Socket) Pin #
Y1702, Y1703, & Y1705 Wiring
Shield
DB 25S (Socket) Pin #
1 7 2 3 4 5 8 6 22 20 11 19 12
1 7 2 3 4 5 8 6 22 20 11 19 12

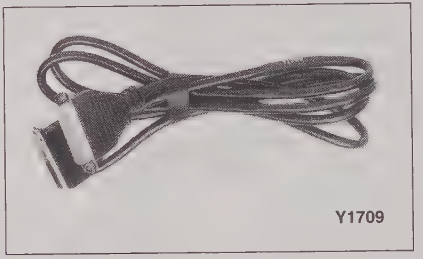


RS-232C Cables

Y1707 Interface Cable 2m (6.56 ft)
Y1708 Interface Cable 10m (32.8 ft)

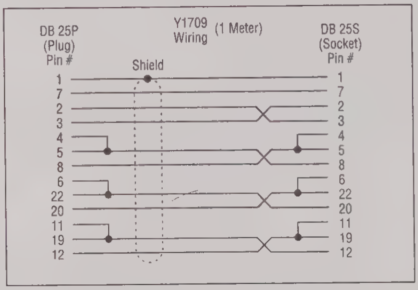

DB 25P (Plug) Pin #
Y1707/8 & Y5003/4 Wiring
Shield
DS 25S † (Socket) Pin#
1 2 3 4 5 6 7 8 11 12 15 17 19 20 22 23
1 2 3 4 5 6 7 8 11 12 15 17 19 20 22 23

†TDB 25P for Y5003 and Y5004



RS-232C Cable

Y1709 RS-232C Printer Cable, 2m (6.56 ft)


DB 25P (Plug) Pin #
Y1709 Wiring (1 Meter)
Shield
DB 25S (Socket) Pin #
1 7 2 3 4 5 8 6 22 20 11 19 12
1 7 2 3 4 5 8 6 22 20 11 19 12

RS-232C Cable

RS40 RS-232C Terminal Cable 1.83m (6 ft) (DB-9 to DB-25 female connector, connects to PC, PC/XT or PS/2)*

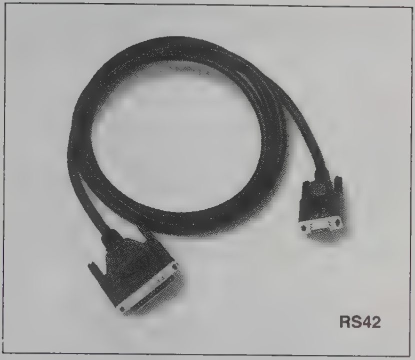
	Connector A	Connector B	
	DB-9S	DB-25S	
	Pin	Pin	RS-232 Name of Computer
45	1	20	Data Terminal Ready*
RX IN	2	2	Transmitted Data
TX OUT	3 ←	3	Received Data
DTR OUT	4 →	6	Data Set Ready
COM	5 →	7	Signal Ground
	6 —	20	Data Terminal Ready*
	7	5	Clear to Send*
	8	4	Request to Send*
	9	Not used	Ring Indicator*

**Optional - may be omitted (unused).*
All other sockets not listed are unused.

RS-232C Cable

RS41 RS-232C Modem Cable (6') (DB-9 to DB-25 male connector)

	Connector A	Connector B	
	DB-9S	DB-25P	
	Pin	Pin	RS-232 Name
45	1	8	Carrier Detect
RX IN	2	3	Received Data
TX OUT	3	2	Transmitted Data
DTR OUT	4	20	Data Terminal Ready
COM	5	7	Signal Ground
	6	6	Data Set Ready
	7	4	Request to Send
	8	5	Clear to Send
	9	22	Ring Indicator


RS42

	Connector A	Connector B	
	DB-9S	DB-25P	
	Pin	Pin	RS-232 Name of Computer
45	1	20	Data Terminal Ready*
RX IN	2	2	Transmitted Data
TX OUT	3	3	Received Data
DTR OUT	4	6	Data Set Ready
COM	5	7	Signal Ground
	6	20	Data Terminal Ready*
	7	5	Clear to Send*
	8	4	Request to Send*
	9	Not used	Ring Indicator*

**Optional - may be omitted (unused).*
All other sockets not listed are unused.

RS-232C Cable

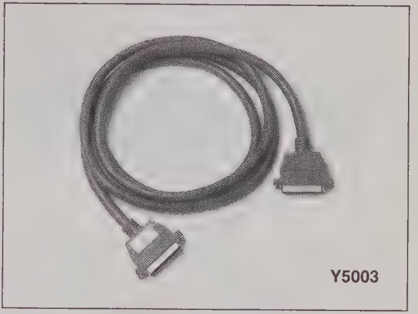
RS42 RS-232C Printer Cable (6') (DB-9 to DB-25 male connector, connects to PC, PC/XT or PS/2)*

RS-232C Cabling Guide

With the addition of Hydra models to our product line, the possible combination of instruments and RS-232C cables have multiplied. To help sort things out we have supplied a table showing which cables work with which models. Cable diagrams are also supplied for the do-it-your-selfers.

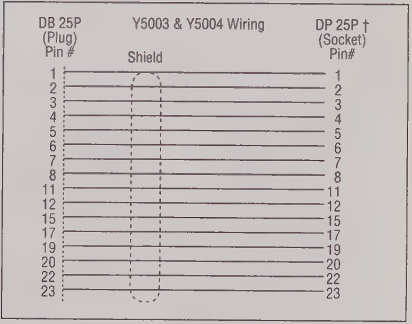
Connect To:	**PC, PC/XT**	**17XXA**	**PC/AT**	**Modem**	**Printer**
Model					
2286A/2285B	Y1702 (1)	Y1702 (1)	Adapter (3) + Y1702 (1)	Y1707 (2)	Y1709
262XA (Hydra)	RS40	RS40	RS40 + RS41	RS41	RS42
2289A/2287A (Helios) Toolbox & General Use	Y1702 (1)	Y1702 (1)	Adapter (3) + Y1702 (1)	Y1707 (2)	Y1709
with LTN	Y1702 (1)	—	Adapter (3) + Y1702 (1)	—	Y1709
with CIMPAC	Y1702 (1)	—	Y1702 (1)	—	Y1709
2400B	Y1702 (1)	Y1702 (1)	Adapter (3) + Y1702 (1)	Y1707 (2)	Y1709
17XXA	—	—	—	Y1707 (2)	Y1709

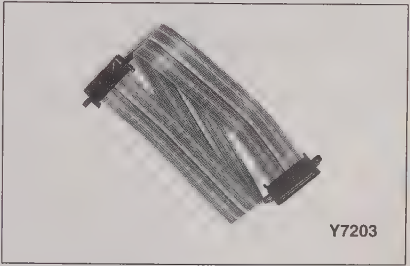
(1) Y1702 is 2 meters long or use Y1703 (4 meters) for extra length. The Y1705 + Y1707 (2) may also be used/.
(2) Y1707 is 2 meters long or use Y1708 (10 meters) for extra length.
(3) 9 to 25 pin adapter is easily available. We have never seen one which will not work. Should match diagram on the previous page.


Y5003

Interface Cables

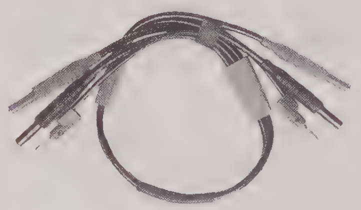
Y5003 Interface Cable 1.52m (5 ft.)
Y5004 Interface Cable 3.05m (10 ft.)




Y7203

Ribbon Cables

Y7203 Ribbon Cable, PTI, 0.6m (2 ft)
Y7204 Ribbon Cable, PTI, 1.52m (5 ft)



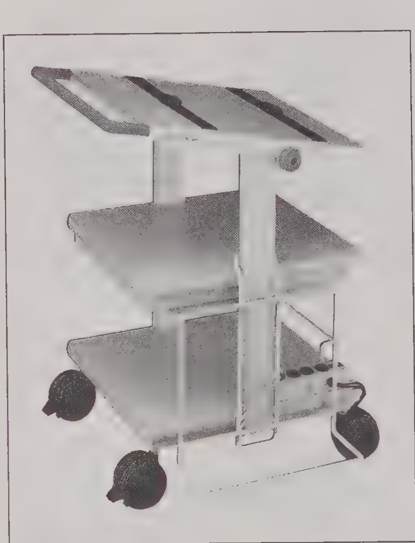
5440A-7002

Low Thermal Test Leads

These low thermal test leads have lower thermal emf than standard test leads, minimizing the emf caused by temperature difference between the ends of the leads.

Length: 24 in ±1 in
Connector Size: 4 mm diameter
Connector Style: Safety type, with a retractable spring-loaded hood. The connector engages with a wiping action.
Thermal EMF: Less than 1.3 µV per °C when measured while engaged in a five-way binding post of Tellurium Copper Alloy 145, half hard.
Leakage Resistance Between Center Conductor and Shield: Greater than $1.0 \times 10^{13}\Omega$ at 45°C and 75% R.H.
Cable Type: RG-58/U type with AWG 20 stranded and tinned center conductor (19 x .0071 in) (Belden 8262 or equivalent).
Safety Ratings: Designed to meet UL 1244 to 1100V ac

5440A-7002 Low Thermal Test Leads

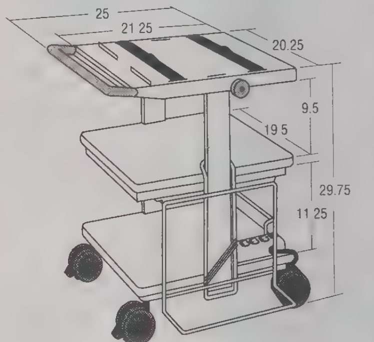


Instrument Transport Cart

The TC100 Instrument Cart* provides three levels of work surface, all of them accommodating 19" wide instruments. It easily combines an oscilloscope or other instruments, and a printer plus paper supply, on one easily movable work station. The top shelf is adjustable over 25 degrees, and has a safety lock. The cart has a 300 lb capacity.

Four 4" casters, two of which can be locked, provide excellent mobility, and options include a line power strip, accessories drawer, and a CPU bracket.

TC100 Instrument Cart
TC100-01 Opt. Power Strip, 4 outlets, UL listed
TC100-02 Opt. Drawer
TC100-03 Opt. CPU Bracket
TC100-04 Opt. Combination of Power Strip, Drawer, and CPU Bracket



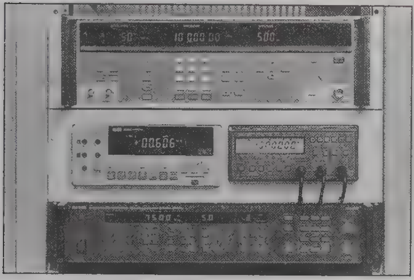
Measurements in inches

Drawer Size: 17.75" W x 19.5" D x 3" H
CPU Bracket Size: 15" W x 5.5' D x 17" H

**Available in North America only*

Rack Mount Kits

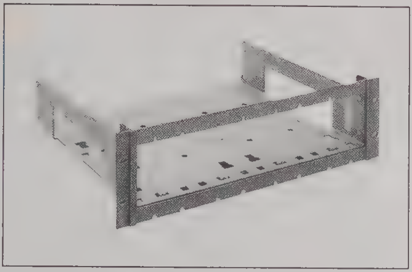
Details on the most popular rack mount kits for Fluke products are included in this section, along with pertinent dimensions, drawings, model numbers and prices. Please also refer to the actual product pages in the catalog for further information; instruments that have kits available will list the kit model number in the Ordering Information block at the end of each product page. Any further questions should be directed to your closest sales office.



Rack Mount Kit HM 9606/00

The HM 9606 rack kit is designed for use with the PM 2534/35 family of DMMs. The HM 9606/00 allows mounting of one PM 6665/6/9 Counter plus one PM 2534/35 DMM or one 8840/42 DMM. The HM 9606/00 requires 5¹/₄" of rack space.

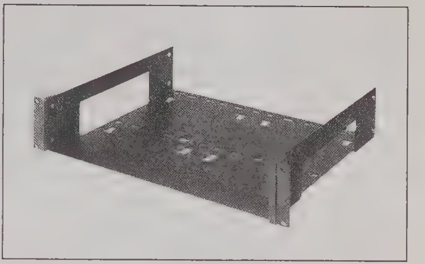
HM 9606/00 Rack Mount Kit



PM 2193/03 19-inch Rack Mount

Can contain up to 8 System 21 units or a combination of 1 PM 2525, PM 2534 or PM 2535 DMM with 4 System 21 units. Unused space can be covered with PM 2194/02 Blank Panels (set of 7).
Height: 3/E (133 mm 5.22")

PM 2193/03 Rack Mount



PM 9280/04 19-inch Rack Mount

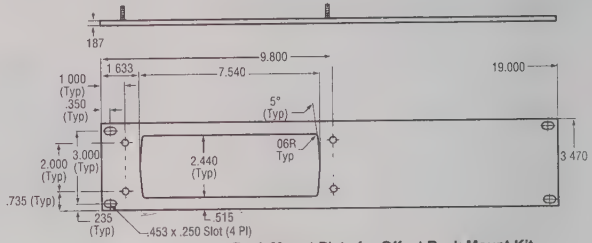
Also fits PM 2534/PM 2535 and up to four System 21 modules.
Height: 2E (89 mm 3.5 in)

PM 9280/04 Rack Mount

8000 Series Instruments

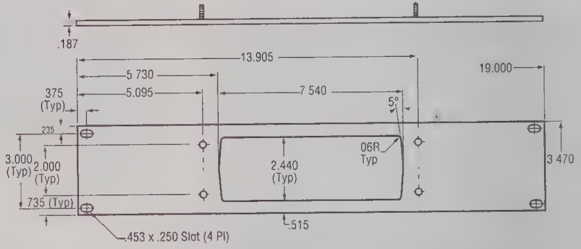
The kit includes two side mounting brackets and one center mounting bracket for the Dual Rack Mount Kit.

For use on Models 8010A, 8012A and the 8050A.



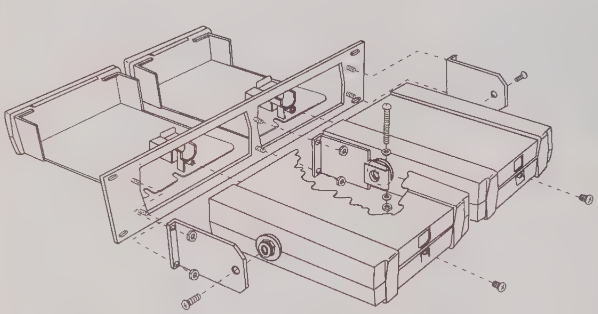
187
9.800
1.633
7.540
19.000
1.000 (Typ)
.350 (Typ)
5° (Typ)
06R Typ
3.000 (Typ)
2.000 (Typ)
2.440 (Typ)
3 470
.735 (Typ)
.235 (Typ)
.515
.453 x .250 Slot (4 Pl)

Rack Mount Plate for Offset Rack Mount Kit

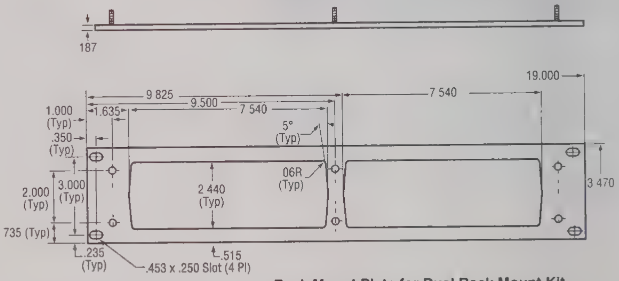


.187
13.905
19.000
5 730
5.095
375 (Typ)
7 540
5°
.235
3.000 (Typ)
2.000 (Typ)
2.440 (Typ)
06R Typ
3 470
.735 (Typ)
.515
.453 x .250 Slot (4 Pl)

Rack Mount Plate for Center Rack Mount Kit



Dual Rack



187
19.000
9 825
9.500
7 540
7 540
1.000 (Typ)
1.635
.350 (Typ)
5° (Typ)
06R (Typ)
2.000 (Typ)
3.000 (Typ)
2 440 (Typ)
3 470
.735 (Typ)
.235 (Typ)
.515
.453 x .250 Slot (4 Pl)

Rack Mount Plate for Dual Rack Mount Kit

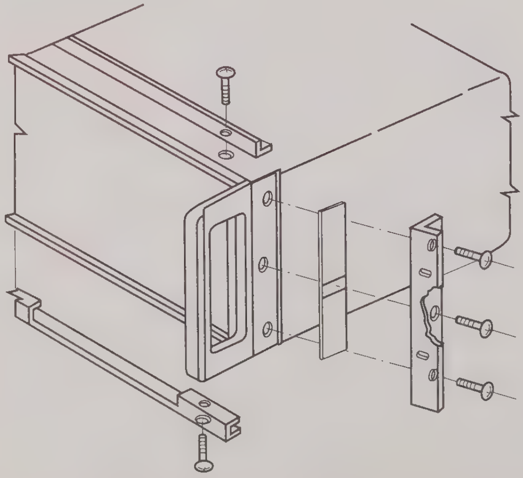
M00-200-611 3$^1/_2$" Offset
M00-200-612 3$^1/_2$" Center
M00-200-613 3$^1/_2$" Dual

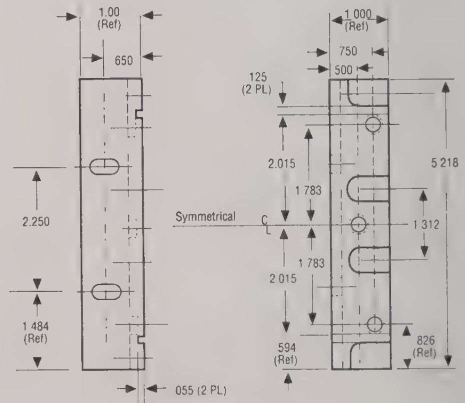
Available through Distributors

Note: Does not include slides. See M00-260-610, M00-270-610, and M00-280-610.

8500 Series Instruments

Kit includes top and bottom filler strips. Material is 0.187" thick. For use on 8505A and 8506A.





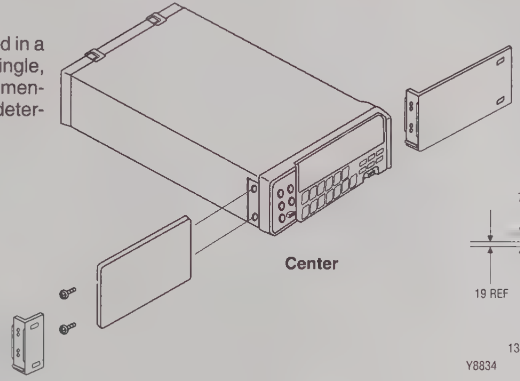
1.00 (Ref)
650
2.250
1 484 (Ref)
055 (2 PL)
1.000 (Ref)
750
500
125 (2 PL)
2.015
1 783
Symmetrical
1 783
2 015
594 (Ref)
5 218
1 312
826 (Ref)

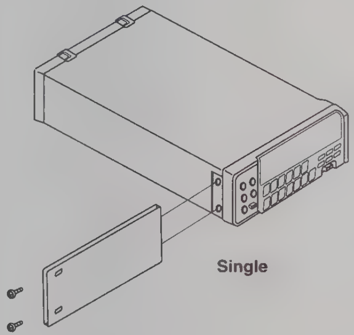
M04-205-600 5$^1/_4$" Rack Mount Kit

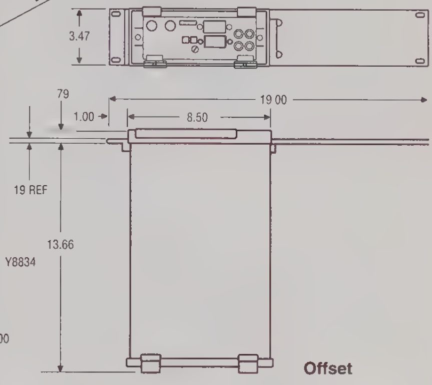
Note: Does not include slides. See M00-260-610, M00-270-610, and M00-280-610.

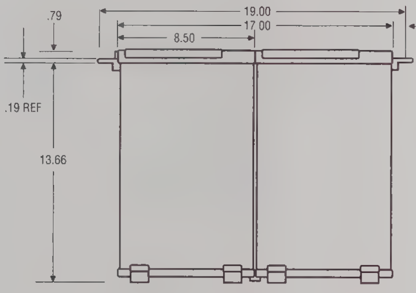
8840 Series Multimeters

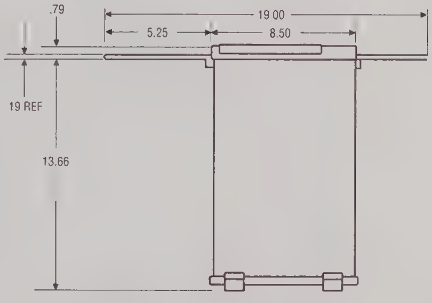
Models 8840A and 8842A can be mounted in a standard 19-inch rack panel using either single, dual or center Rack Mount Kit. External dimensions for the kit are provided to help you determine space requirements.


Center


Single


3.47
79
1.00
8.50
19 00
19 REF
13.66
Y8834
Offset


.79
19.00
17 00
8.50
1 00
.19 REF
13.66
Dual

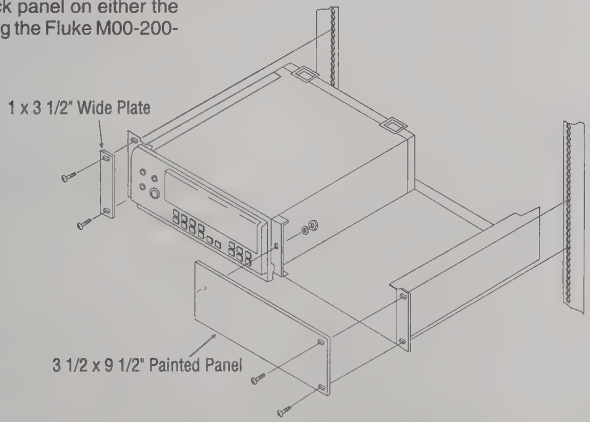

.79
19 00
5.25
8.50
19 REF
13.66
Center

Y8834 3½" Rack Mount Kit, Single
Y8835 3½" Rack Mount Kit, Dual
Y8836 3½" Rack Mount Kit, Center

Note: Kit includes all required hardware

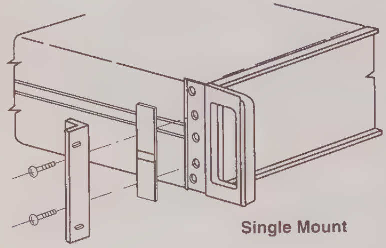
Fluke 45 or Hydra Series

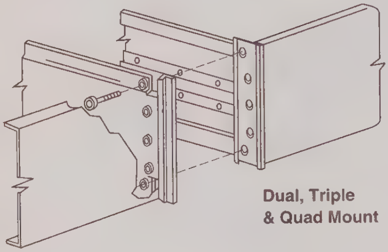
The Fluke 45 or Hydra Series can be mounted in a standard 19-inch rack panel on either the right or left hand side using the Fluke M00-200-634 Rack Mount Kit.

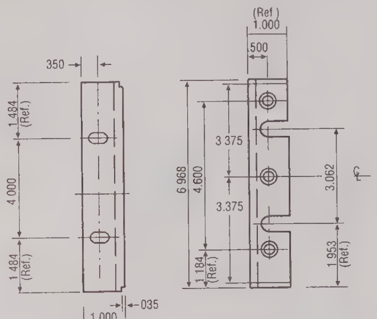

1 x 3 1/2" Wide Plate
3 1/2 x 9 1/2" Painted Panel

M00-200-634 Rack Mount Kit

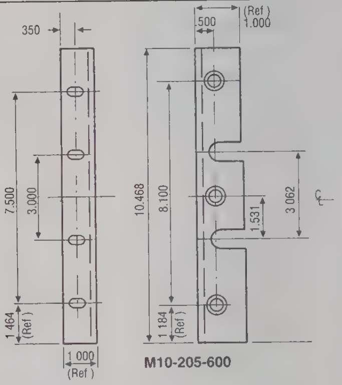
Modular Series Instruments


Single Mount

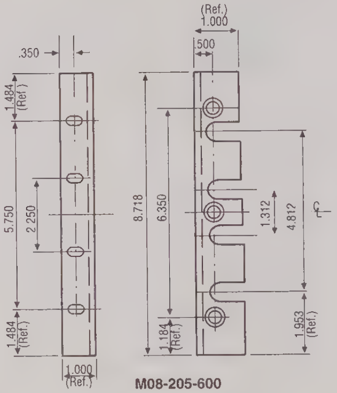

Dual, Triple
& Quad Mount


350
(Ref.)
1.000
.500
1.484 (Ref.)
4.000
1.484 (Ref.)
.035
1.000 (Ref.)
6.968
4.600
3.375
3.375
1.184 (Ref.)
3.062
1.953 (Ref.)
℄

M07-205-600

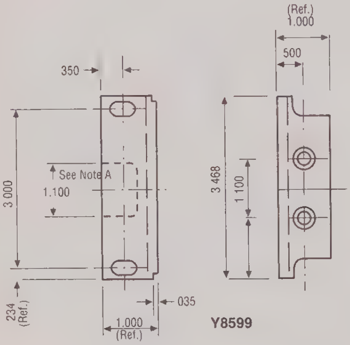

350
.500
(Ref.)
1.000
7.500
3.000
1.464 (Ref.)
1.000 (Ref.)
10.468
8.100
1.531
3.062
1.184 (Ref.)
℄

M10-205-600


.350
(Ref.)
1.000
.500
1.484 (Ref.)
5.750
2.250
1.484 (Ref.)
1.000 (Ref.)
8.718
6.350
1.312
4.812
1.184 (Ref.)
1.953 (Ref.)
℄

M08-205-600

Rack Ear Dimensional Drawings

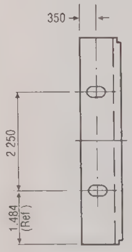

350
(Ref.)
1.000
.500
3.000
See Note A
1.100
.234 (Ref.)
.035
1.000 (Ref.)
3.468
1.100

Y8599

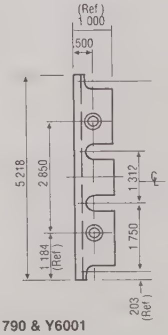
Note A: This U shaped cut-out is only on the Y8599 Kit.

Model (1)	Module Height mm (inch)	Instrument Description	Rack Ears Qty.	For Use On
M07-205-600	177.0 (7)	Side-by-Side	2	2205A, 5200A, 5220A, 6160B
M07-200-603	177.0 (7)			732 & 752A
M08-205-600	221.5 (8³/4)		2	5100/01B, 2400 Series, 5440B, 5442A
M10-205-600	265.9 (10¹/2)		2	5205A, 5215A
Y1790 (2)	132.6 (5¹/4)		2	1722A, 1752A
Y8598 (3)	88.1 (3¹/2)			8520A, 8522A, 5450A
Y8599	88.1 (3¹/2)		2	8520A, 8522A, 5450A

(1) Rack Slides are not included unless otherwise stated
(2) Rack mount kit includes 2 pair 24" slides
(3) Rack mount kit includes 2 pair 22" slides


350
2.250
1.484 (Ref.)

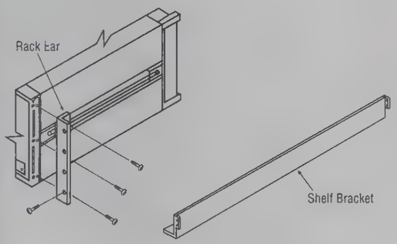
M05-205-600


(Ref.)
1.000
.500
5.218
2.850
1.312
℄
1.184 (Ref.)
1.750
.203 (Ref.)

Y1790 & Y6001

2280 Series

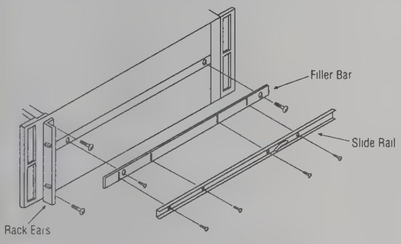
The Y2044 Rack Slide Kit facilitates the servicing of the instrument while it is installed in a standard 19-inch electronic equipment rack. The unit is secured in the equipment rack, yet may be pulled out along the slide for reconfiguring of serial link devices and servicing. The Y2045 Rack Mount Kit facilitates the placement of an instrument into a standard 19-inch rack.



Y2044 Rack Slide Kit w/24" Slides
Y2045 $8^{3}/_{4}$" Rack Mount Kit

734A & 5700 Series

The 734A, 5700A Calibrator or the 5725A Amplifier are mountable in a standard 19.12-inch panel opening E.I.A. universal spacing equipment rack. Model Y734 is for the 734A. Model Y5737 is for the 5700A and 5790A. Model Y5735 is for the 5725A. Kit contents and instructions for installation are the same for both kits, except for the size of the rack ears and usage of filler bar to slide rail mounting holes.



Y5735 Rack Mount Kit w/24" Slides
Y5737 Rack Mount Kit w/24" Slides

Rack Slides

The units in the previous pages with a M00-number have provision for rack slides. These slides are the M00-260-610 (18" long). M00-270-610 (20" long), and M00-280-610 (24" long).

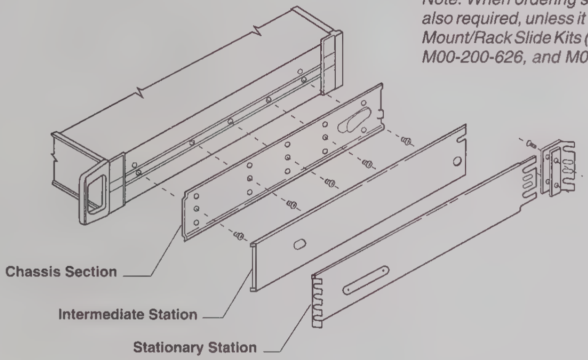
These are devices allowing the instrument to be pulled straight out, after panel screws are removed, for servicing. They are normally only put on larger heavier instruments that can't be easily lifted out to a workbench. The rack slides are bolted to the side of the instrument and Fluke units with provisions for slides have matching tapped holes under a decorative strip on each side.

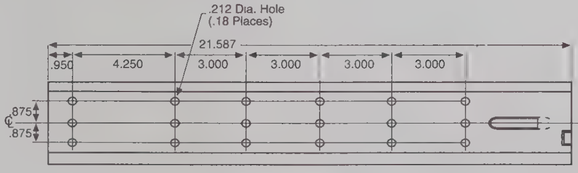
In order to match with the holes in the panel rail, rack slides are mounted in the center of a $1^{3}/_{4}$" module. Instruments whose panel height is an odd number of $1^{3}/_{4}$" modules has rack slides on the center line. Those with an even number have the slides $^{7}/_{8}$" above or below the center line. The Fluke M00 slides have provisions for this $^{7}/_{8}$" offset.

Three slide kits are available, one for 18" racks, 20" racks (between front and rear cabinet panel rails) and one for 24" racks. Both have rear brackets with $1^{1}/_{2}$" adjustments.

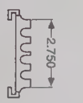
Matl: Hard, cold rolled steel.
Finish: Cadmium plated. Will withstand JAN 100 hr. salt spray.
Load Capacity: 125 lb may vertical load per pair when extended.

Note: When ordering slides, the Rack Mount Kits are also required, unless it is one of the combination Rack Mount/Rack Slide Kits (Y1790, &6061, Y7206, Y8598, M00-200-626, and M00-203-631).

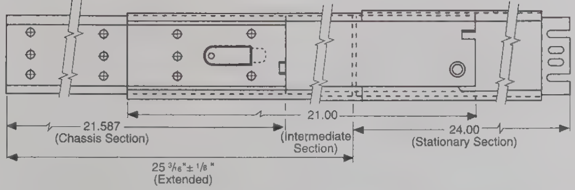




Chassis Section



Front Mounting Bracket
Stationary Slide Sections



Order No.*	Height	Chassis Section (A)	Extension (B)	Intermediate Section (C)	Stationary Section (D)
M00-260-610	$3^{1}/_{2}$	17	$22^{1}/_{4}$	17	18
M00-270-610	$3^{1}/_{2}$	19	$22^{1}/_{4}$	17	20
M00-280-610	$3^{1}/_{2}$	23	$26^{1}/_{4}$	21	24

**Rack Mount Kits are required when ordering Rack Slides*
Note: All mounting hardware furnished

Selection Guide for Fluke PM nomenclature 19" Wide Rack Mounts

Models	Recommended Rack Mount	Height (1)	Blanking Panel
System 21 only (8 units max)	PM 2193	3E	PM 2194/02 (2)
System 21 combined with other models (3)	PM 2193	3E	PM 2194/02 (2)
PM 252x/3x (1 unit)	PM 9280 (5)	3E	included
PM 252x/3x (2 units)	PM 2193	3E	not included
PM 252x (1 unit) and PM 666x (1 unit)	HM 9606/00 (6) or PM 9280 (5)	3E	included
PM 2811 (1 or 2 units)	PM 9280 (5)	2E	included
PM 2812/3, PM 2831/32	rack mount ears standard	2E	not needed
PM 3050/55/65/70	PM 8969	4E	included
PM 3052/57/67/72	rack mount ears standard	3E	not needed
PM 3092/94	PM 8960/04	4E	included
PM 3335/50/50A/55/65/65A/75	PM 8969	4E	included
PM 3337/52A/67A/77	rack mount ears standard	3E	not needed
PM 3382/84/92/94	PM 8960/04	4E	not needed
PM 358x	no rack mount available	—	—
PM 5131/2/3/4	PM 9560	4E	included
PM 5138/9	PM 9563	3E	not needed
PM 5190	PM 9560	4E	included
PM 5191/2/3	rack mount ears standard (8) PM 9613/01 – optional slide kit	2E	not needed
PM 5514V/15/18	PM 9561	4E	included
PM 5712/15	no rack mount available	—	—
PM 5781*	rack mount ears standard (8) PM 9613/01 – optional slide kit	2E	not needed
PM 5785*/6	PM 9561	4E	included
PM 6303A, PM 6304 (11)	PM 9564	2E	not needed
PM 666x (1 unit)	HM 9606/01	3E	included
PM 666x (2 units)	HM 9606/03	3E	included
PM 666x (1 unit) and PM 252x/3x (1 unit)	HM 9606/00	3E	included
PM 667x (1 unit)	PM 9669/01	3E	included
PM 667x (2 units)	PM 9669/02	3E	included
PM 6680	PM 9622/00	2E	included
PM 6685	PM 9622/02	2E	included

**Discontinued Products*

(1) Height that the rack mount plus the instrument (s) will take up in the rack. E = 1 Engineering Unit = 1.75 inches.

(2) PM 2194/02 contains 4 blanking panels: 1 1.5E high panel to blank 4 spaces at the top of the PM 2103/02 rack mount, and 3 1E high panels to blank 3 individual spaces.

(3) Up to 4 System 21 units can be rack mounted with one of any of the following models: Fluke 45, Fluke 8840A, Fluke 8842A, PM 2525, PM 253x, PM 666x or PM 2811.

(4) HM 9606/00 and HM 9606/02 can alternatively hold the following DMMs: Fluke 45, Fluke 8840A or Fluke 8842A.

(5) Any combination of 1 or 2 of the following instruments can alternatively be rack mounted using the PM 9280/04: Fluke 45, Fluke 8840A, Fluke 8842A, PM 666x or PM 253x. NOTE: The PM 2525 will not fit in this rack mount.

(6) Remove the feet from the unit before mounting in the rack.

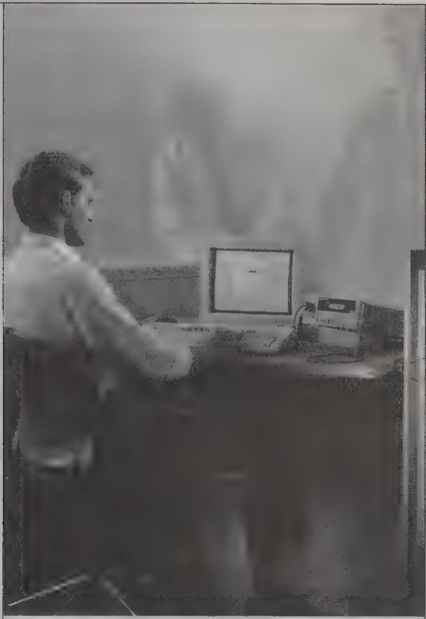
(7) PM 6303A shipped before October 1992, choose PM 9653 (3E).

Models*

HM 9606/00
HM 9606/01
HM 9606/02
HM 9606/03
PM 2193/03
PM 8960/04
PM 8969
PM 9280/04
PM 9560
PM 9561
PM 9563
PM 9564
PM 9613/01
PM 9622/00
PM 9669/01
PM 9669/02

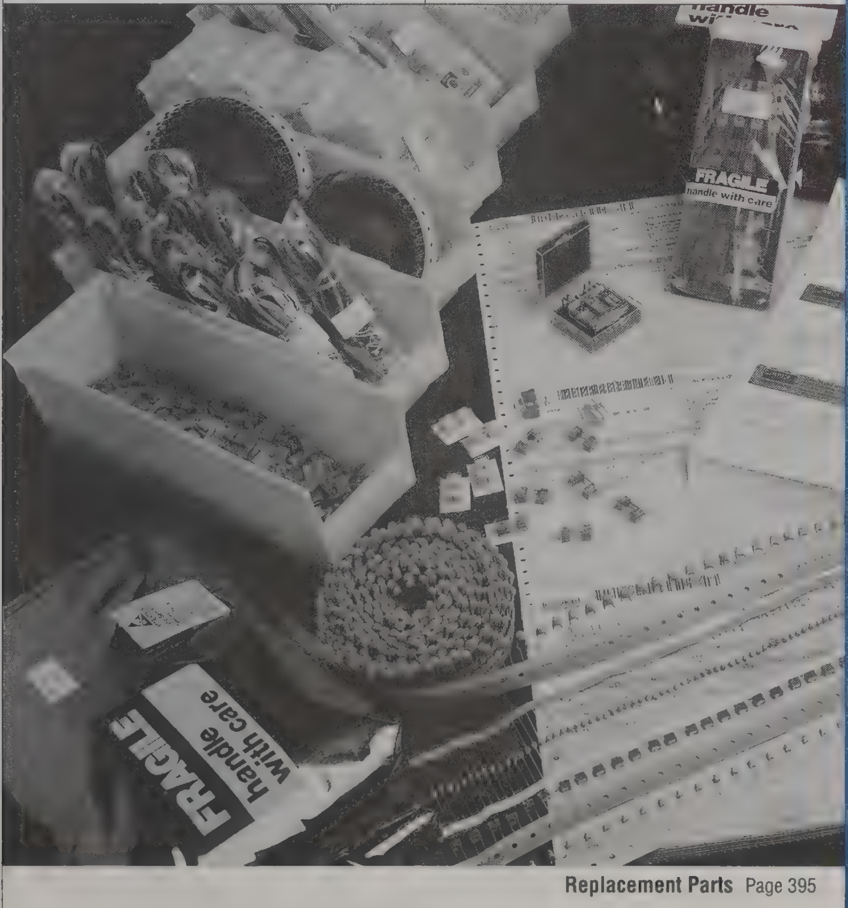
** Contact your local Fluke Sales Office for additional information and drawings on PM number rack mounting.*

Customer Support Services



Repair & Calibration Page 394

Standard Price Repair Page 395



Replacement Parts Page 395

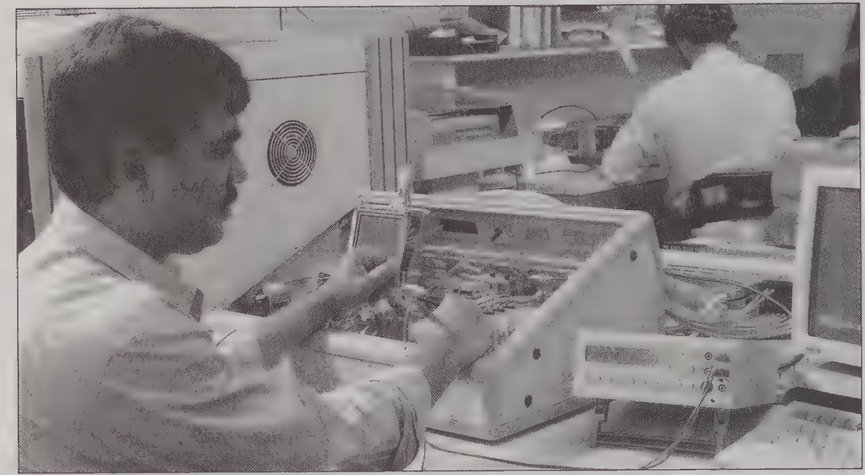
Worldclass Products, Worldwide Support

As ISO standards for development and manufacturing processes become more and more important for manufacturers to compete in the world marketplace, our customers require more frequent assurance their development, test, and manufacturing tools are functioning properly. Fluke is more than a manufacturer of high quality electronic test tools. We are also dedicated to providing high quality services to support our products in your applications. To protect your product investment, Fluke Service Centers are located at strategic locations worldwide to support you with calibration, repair, and self-maintenance services, including service parts, manuals, and product upgrade kits.

To ensure you realize maximum productivity from your equipment and assist you in building the base for your own ISO quality management program, Fluke is committed to help you achieve the highest possible quality standards. We can help you keep your test, measurement, and calibration equipment at consistently high levels of operation and accuracy. Fluke is dedicated to ISO standards in controlling our own processes and quality of support.

Repair & Calibration	Page 394
Standard Price Service	Page 395
Replacement Parts	Page 395
Extended Warranty Service	Page 396

Repair & Calibration



Repair & Calibration Services
Variety of services to meet each customer's needs
Installation of product improvements
Calibration and/or alignment traceable to National Standards
Documented quality assurance program
Special calibration data available

Each Fluke Service Center is equipped with the necessary instruments, standards, procedures, and personnel to maintain Fluke products at peak performance. Proper use of measurement standards is carefully and continually monitored through a corporate controlled audit program.

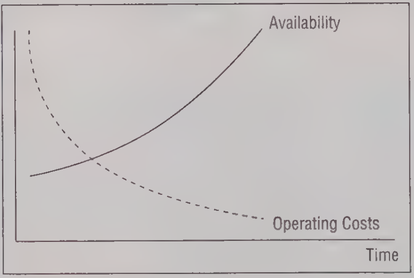
Fluke's Customer Support Services group is dedicated to a single goal: providing the best possible service for both our products and our customers.

Every service is designed to meet a different level of product support, whether it's a single unscheduled repair or a full service agreement.

It Pays to Calibrate Regularly

Measuring instruments are the 'heartbeat' of your company as they check and measure your production process. They control the quality of your products and are thus in the end responsible for the success and the profitability of your business.

A regular check of your 'heartbeat' with traceable calibration equipment is essential. First, it ensures your quality always matches the customer's expectations which is vital where ISO 9000 certification is involved. Second, regular calibration pays dividends.



Calibration optimises your process control

The advantages of regular calibration are:
- Consistent quality of your production output
- Lower operating cost due to enhanced reliability
- Optimal access to international markets
- Establishing a quality system
- Address quality audit and reviews
- Maintain quality of specifications
- Meet production control criteria
- Measure inspection and testing results
- Establish calibration traceability

ISO 9000: Traceable Calibration

'Calibration' means that the test results from a measuring device (or source) of unknown accuracy, are compared with a device whose accuracy is known. This device is universally accepted as a 'reference' and traceable to international standards. Calibration records any deviation from this standard and corrects it when necessary. Each instrument has a specific calibration procedure which indicates exactly how and what must be checked.

Regular and traceable calibration combines the forces of accuracy and certainty and provides you with the key aspect of ISO 9000 registration. Contact your nearest Fluke Service Center for more information on these services.

CalNet®: The European Specialist in Calibration

Fluke has set up more than a dozen calibration laboratories all over Europe, which work together as a single network.

CalNet can issue the calibration certificates you need to meet ISO 9000 standards. CalNet guarantees traceability and access to the best calibration facilities the network can offer. Because of constant information exchange and comparing standards within the network, traceability increases while inaccuracy and uncertainty decreases.

CalNet is able to help you meet the calibration needs of not only equipment made by Fluke but also other manufacturers' products. It is a network that provides you with some real key advantages:
- CalNet laboratories are approved by and traceable to the National Standards Institutes.
- Each laboratory is a link in the chain of an active network. Sharing information, expertise and the same quality standards.

The need for calibration is directly related to the specific tasks performed by your equipment. CalNet is able to provide you with services tailored to your need which include:
- Performance verification check for simple test equipment. The CalNet sticker placed on your instrument after testing is your guarantee that it operates as specified.
- CalNet Certificate including a calibration report. When you need to know the exact results of the calibration.
- National calibration certificate if you need direct traceability to the National Standards Institutes.
- CalNet offers complete inventory and maintenance management of your installed test and measuring equipment including equipment of other manufacturers. One address for all your equipment maintenance and service needs.

Special Services
Calibration documentation
Fast emergency service
Handle all your service needs with one simple plan

Please contact your nearest Fluke Service Center for local availability and terms of this service.

Standard Price Repair

- One-time repair or calibration at a fixed price
- Added support for your own maintenance program
- Take advantage of Fluke's expertise and resources on an as-needed basis

These cost-effective services can be used to repair or calibrate your Fluke equipment on a one-time basis. For customers who routinely service their own instruments, this service offers an easy way to smooth out your peak work loads. For others, it's an easy and economical way to take advantage of Fluke's extensive service capabilities.

The Standard Price Service Program sets a fixed charge for calibration and/or repair for each type of instrument. The calibration and/or repair price includes all labor and most materials required.

These standard prices, which are based on historical time and material averages, help you determine service costs in advance. They also obviate potentially critical delays caused by quotation and approval procedures. Of course, some units may fall outside the scope of the program because of age or abuse. In such cases you will be advised and, only with your approval, charged on the basis of the actual labor and parts required.

Please contact your nearest Fluke Service Center for local availability and terms of this service.

Standard Price Calibration

Routine calibration ensures your instrument is performing to published specifications. Every instrument calibration follows the procedures detailed in our maintenance and service manuals. Instruments are returned with a Certificate of Calibration, your proof of traceability to international standards. We also include calibration labels which indicate the date of calibration plus seals to protect the integrity of the calibration performed.

Please contact your nearest Fluke Service Center for local availability and terms of this service.

Standard Price Repair Plus Calibration

This is a cost-effective way to service your Fluke instruments on a one-off basis. Using the industry's finest test equipment, our factory-trained technicians will test all function and ranges while making the necessary repairs. We replace any defective parts with Fluke specified and tested parts to ensure the repaired instrument performs to published specifications. During repair, we will also install product changes that enhance the instrument performance and reliability. It is subsequently calibrated in the same way as in the Standard Price Calibration service, inclusive of the same certification, labels and seals. Each unit is completely performance tested and returned with a service report.

Please contact your nearest Fluke Service Center for local availability and terms of this service.

Replacement Parts

- Components meeting Fluke original equipment standards
- Automatic notice of improved replacement types
- 90-day warranty
- Recommended spare parts and module kits

Availability of replacement parts is a key element in providing quick turnaround and product support for customers who perform their own maintenance. By providing quality parts and responsive support, Customer Support Services will help return your Fluke products to peak performance.

To support this service, an extensive inventory of repair parts is maintained by our Replacement Parts Centers. These computerized centers stock several hundred thousand components, subassemblies, and modules. All replacement parts are warranted against defects in materials and workmanship for 90 days after shipment.

Place your orders with your nearest Fluke representative or Fluke Service Center. They will expedite processing or fill your order from the local inventory.

When ordering, please identify parts by the Fluke 6 or 12-digit part number and description as shown in the instrument manual and, if possible, by the schematic diagram circuit reference number. The model number and serial number will also help us supply the correct parts.

In some cases parts must be ordered in matched sets in order to maintain the specified accuracy and performance of the instrument after repair. Check the listings and diagrams for footnotes which contain the instructions for ordering special parts.

Recommended Spare Parts Lists and instrument manuals are also available for many Fluke products.

Many Fluke instruments are modular in design and can be serviced most effectively by exchanging a defective module. Fluke has a Module Exchange Program that allows you to order a replacement module in exchange for your defective module.

Please contact your nearest Fluke Sales or Service location for local availability and terms of this service.

Extended Warranty Service

- Fixed maintenance costs allow accurate yearly budgeting
- Prioritized service
- Shorter repair cycle
- Reduced parts inventory
- Lower maintenance training costs
- Less demand on your technical personnel and resources

The Fluke Extended Warranty Plan provides ultimate equipment protection at an economical price. Comprehensive agreements provide routine calibration at regular intervals or repair service as needed. You can, of course, combine these options for full service coverage.

Extended Warranty Repair Plan

This plan is an extension to your product warranty. Whenever your product needs repair or service, simply send it to the nearest Fluke Service Center. It will be repaired, recalibrated, and performance tested – with priority scheduling. All parts and labor are included in the price of this service, even parts that are normally excluded from the Standard Price Service plan. So there won't be any surprises, even return freight costs are included. As you might expect, a Fluke Service Report and Certificate of Calibration is enclosed with each repaired instrument. Contact your nearest Fluke Service Center for availability and complete terms of the extended warranty.

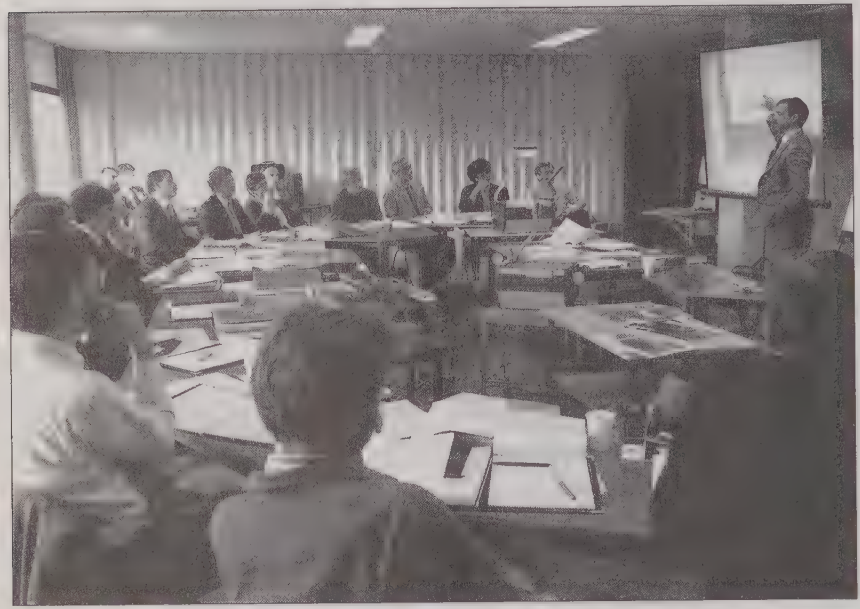
Full Service Extended Warranty

If you need both scheduled calibration and periodic repair service, there is no better maintenance program for your equipment than our full service plan. It combines all the features of the Extended Warranty Repair into a single integrated full service plan. You pay a reasonable fee for each instrument and eliminate most additional service expenses.

Please contact your nearest Fluke Service Center for local availability and terms of this service.

Pre-Plan Inspections

Sometimes an instrument inspection is required before we can offer an Extended Warranty plan. This usually occurs when an instrument's warranty has expired. Should the condition of the equipment preclude coverage we will provide a Labor and Materials Service quote for the repairs necessary to qualify your instrument.



Fluke offers you an array of training courses on the application of specific instruments and systems, as well as more general courses on certain measurement principles and techniques.

Instrument-specific courses focus on application needs, and enable you to get the maximum benefit from a certain system or instrument in the shortest possible time. Rather than having to learn functions and procedures by rote, you will gain a systematic insight.

Courses on general measurement concepts and principles allow you to share in the technological expertise that Fluke has in this field. These courses go beyond features and benefits: you will extend your knowledge base and learn to use it creatively.

All courses are led by instructors who are experts in the subject matter, and include practical exercises. The emphasis is on methods and techniques that you can put into practice immediately. In this way you will use your Fluke instruments more effectively and more efficiently, saving you time and money.

Please contact your nearest Fluke representative or Fluke Sales Office for local availability, course descriptions, and terms of this service.

Customer Training Services

- Product Applications Courses
- General Technology Workshops
- Special Customer Training Packages

Professional Training Pays Off in Productivity

In our over 40 years experience in designing and manufacturing test and measurement instrumentation, we've learned that proper training is critical to ensuring integrity and confidence in electronic research and design, manufacturing, calibration, and service.

As a customer and user of Fluke equipment, we feel the more you know about our instruments, the more your productivity will increase. And we feel the best way to realize the total performance potential available is to spend a few days training with our experts. These highly-trained professionals are experienced in the latest technology related to your business, and teach technical subjects in a manner that's both easy to understand and apply to your job. Comprehensive lectures are combined with hands-on experience, and you'll leave with a sound understanding of our equipment and documentation.

Glossary of Terms

Glossary

Absolute Accuracy. See Absolute Uncertainty.

Absolute Uncertainty. Uncertainty that includes contributions from three sources: (1) traceability to national standards, (2) the measurement process, and (3) relative uncertainty of the measuring instrument(s). Absolute uncertainty should be used to compute test uncertainty ratio. Also see **Relative Uncertainty**.

Accuracy. The extent to which the measured value of a quantity agrees with the accepted, consensus, or true value of that quantity. The accuracy of a measurement is its "closeness" to a defined true or reference value. For example, a measurement that is uncertain by ±1% is 99% accurate. Accuracy however is also sometimes used to mean uncertainty. Also see **Uncertainty**.

Acronym. Initials of descriptive name that can be pronounced as a word. For example, "PROM" for Programmable Read-Only Memory.

Adaptor. A device that allows test fixtures from one type of receiver to be used on another type of receiver.

Address. A coded number representing the location of an item. Examples include bus address and program address.

Adjacent Trace Short. A short resulting from an inadvertent connection between two adjacent traces.

Aliasing. False reproduction of an input waveform in a Digital Storage Oscilloscope, for instance, caused by under-sampling.

Analog-to-Digital Converter. A circuit module that changes a voltage or current into a digitized number that can be displayed or further analyzed by digital circuitry.

ANSI. American National Standards Institute, Inc., a group that approves and publishes written U.S. Industry standards.

Application Software. A program running on a host computer designed to perform specified functions in a working environment.

Artifact Calibration. An instrument calibration technique that uses a calibration system within the instrument to reduce the number of required external standards to a small number of artifact standards. The Fluke 5700A Calibrator uses Artifact Calibration.

Artifact Standard. A stable object that produces or embodies a physical quantity for use as a reference standard. An artifact standard may have an assigned traceable value when used for calibration purposes. Fluke 732A dc Voltage Reference Standard and the Fluke 742A Series Standard Resistors are examples. Also see **Transfer Standard**.

ASCII. American Standard Code for Information Interchange as defined by ANSI document X3.64-1077. ASCII is a standardized code set for 128 characters, including full alphabetic (upper and lower case), numerics, punctuation, and a set of control codes.

Astigmatism. Measure of the roundness of the spot on a CRT screen.

Asynchronous Data. Information transmitted or received at random times with respect to a particular system. Also see Synchronous Data.

ATE. Automated test equipment, including systems such as manufacturing defects analyzers, functional testers, and incircuit testers.

Autolearn. A capability of a board tester to automatically learn the connectivity of components on a loaded board.

Automatic Test Equipment (ATE). Any type of test equipment having a stored program that controls its operation.

Automatic Test Program Generator (ATPG). A software program that generates a test program from board descriptions.

Autopolarity. A feature of a digital voltmeter or digital multimeter wherein the correct polarity (either negative or positive) for a measured quantity is automatically indicated on the display.

Autoranging. The capability of an instrument to automatically select the most appropriate range in response to an applied stimulus or requested output.

AUTOSET. Autoset is an automatic feature on Philips oscilloscopes which first identifies which channel shows a triggerable signal, turns that channel on, selects the lower frequency signal to trigger the scope, adjusts the attenuator of each channel, and selects a timebase speed to show more than two, and less than five periods of the input signal.

Average Responding. A measurement that uses the dc average of the rectified ac which is scaled to indicate RMS value. In the case of a pure sine wave the dc is multiplied by 1.11 to indicate the RMS value.

Back-Driving. An in-circuit measurement technique for digital components. Truth table patterns are applied to digital devices in the circuit in such a way that the normal inputs to the devices are over driven by the tester.

Backplane. An electronic system module whose primary function is to interconnect other modules.

Bandwidth. The range of frequencies within which performance remains within specified limits.

Bare Board. A printed circuit board (PCB) without components.

Base Units. Units in the SI system that are dimensionally independent. All other units are derived from base units. The only base unit in electricity is the ampere.

Baud Rate. The serial transfer rate in bits per second including all framing bits used to identify the start and end of codes or messages.

Beamfinder. Found on older scopes since the 60's. Assists in confirming, at the push of a button, that signals (if any) are off scale, either by too high an amplitude, or too much shift, or both. Beamfinders limit the display of these off-scale images by reducing the dynamic range of the scope's display amplifiers, thereby "collapsing" everything into a fuzzy image around the center of the CRT. When releasing the Beamfinder button, the situation is back to as before: lost! AUTOSET is a modern and clever approach to assisting the user.

Bed-Of-Nails Fixture. Text Fixture. Test Head. A surface in which spring pins are strategically located to make electrical contact with the board under test.

Glossary of Terms

Binary. A base-two number system using the symbols "0" and "1". Binary codes are more easily handled by digital computer circuitry that uses bistable "off" or "on" states to store and process information.

Bit. A mnemonic for binary digit, the smallest single unit of computer information. Bits are normally represented as "0" or "1", and are often used in groups to represent addresses, numbers, or codes. Also see **Byte**.

Break-Before-Make. The action of opening a switching circuit before closing another associated circuit.

Buffer. (1) An area of digital memory for temporary storage of data. (2) An amplifier stage before the final amplifier.

Burden Voltage. Voltage drop across the input terminals of a current-measuring device, caused by internal shunt resistance. Burden voltage contributes measurement error, and should be as low as practical.

Byte. A group of eight bits. Information in computer memory is typically arranged as an array of bytes.

Calculated Cursor Measurements. In a DSO, the ability to calculate amplitude and time values, other than delta Volts and delta time. Examples are RMS, Vpp, Vabs, Over/Undershoot, Risetime, Period time, Frequency etc.

Calibration. The comparison of a measurement or source device (UUT) of unverified uncertainty with a measurement or device of known and lesser uncertainty, to report or correct variations. Calibration may or may not include adjustment of the UUT or assignment of values to its responses. Also see **Traceability** and **Verification**.

Calibration Constant. A correction to be applied to the output or reading of an instrument. It may be applied manually or automatically. Also see **Closed Loop Calibration**.

Certificate of Calibration Practices. For every serialized, non-distributor product, Fluke automatically provides a Certificate of Calibration Practices free of charge. This certificate states that the instrument was calibrated with standards that are traceable to the National Institute of Standards and Technology (NIST) in accordance with the requirements of MIL-STD-45662A.

Certificate of Calibration (Traceable to NIST). At the customer's request, traceability to NIST for an individual instrument can be established at the factory. As evidence of traceability, MIL-STD-45662A **Certificate of Calibration**, a calibration label indicating date of calibration, a calibration seal to prevent tampering and a printout of outgoing readings are provided.

Channel. A term that refers to the electrical and mechanical elements that interface a UUT test point to the tester's stimulus and measurement circuitry.

Character. A member of a set of elements used for representing data visually. Characters are distinct from codes in that they are visual representations of data, while codes are numeric representations of data.

Character Cell. The portion of the display that is used to display a character. Typically expressed in terms of pixels.

Characterization. A calibration process that produces a table of calibration constants for use in correcting the output or reading of an instrument.

Character Set. A collection of characters used by terminal devices to display information. Character sets commonly contain 128 characters.

Character String. A grouping of ASCII characters.

Check Standard. A stable standard used to verify the integrity of another standard or measurement process. For example, in the 5700A, one Fluke rms sensor continuously monitors the output voltage while a second Fluke rms sensor confirms the integrity of the first.

Closed Loop. A circuit in which the output is continuously fed back to the input for constant comparison.

Closed Loop Calibration. A fully automated calibration process in which the calibration system reads the UUT response to each stimulus and supplies an appropriate calibration constant for storage within the UUT.

Combinational Board Tester (CBT). A tester capable of performing both In-circuit and Functional testing.

Combination Oscilloscopes. Some DSOs can be switched back and forth between their DSO mode of operation, and an analog mode of operation, with no digitizer, and no memory in use. Sometimes this is used to verify the credibility and familiarity of the input signal.

Common Mode Noise. Noise that exists between both terminals of a measurement source device and ground. Also see **Noise** and **Normal Mode Noise.**

Common Mode Rejection. For a measurement device, the ability to measure a signal in the presence of common mode noise. For a source device, the maximum level of common mode noise that might appear on the output terminal. Common mode rejection is normally specified as a ratio (dB).

Compliance Voltage. The output voltage of a constant-current source. For a current calibrator, a "maximum compliance voltage" specification defines the load limit for which the calibrator can maintain uncertainty specifications.

Component Side. The side of the PCB onto which components are mounted.

Confidence Level. A statistical percentage indicating the likelihood of successfully isolating all faults.

Contact Panel. Interface. The part of the test fixture that connects to the receiver.

Controller. The system element that controls the operation of a tester. A PC is often used for this purpose.

Control Sequence. A sequence of codes that produces a desired response. Examples are display control sequences for such responses as cursor position or blinking.

Conversion Time. The time required for a complete measurement by an analog-to-digital converter.

Crest Factor. The ratio of the peak voltage of an ac waveform to its rms value, with any dc component removed. For an alternating voltage or current meter, crest factor expresses its ability to respond to non-sinusoidal waveforms.

Glossary of Terms

Current Guard. A voltage source in phase with a current source, intended for shielding the current output. For example, the Fluke 5700A Calibrator includes a current guard on its rear terminal block. When connected to the inner shield of a triaxial cable with low-level ac current output on the center conductor, it shields the output from a capacitive leakage path to ground.

Cursor. The visible pointer on the CRT display that indicates to the user the position where the next character will appear.

Cursors. Electronically displayed reference lines or markers in an oscilloscope display. Cursors can measure the distance between them and express this distance in voltage or time values.

Data. Any representation of information in a formalized manner suitable for communication, interpretation, or processing by manual or automatic means.

Data Analysis. The organization and interpretation of test results in such a way that needed corrective actions become apparent.

Data Logging. The recording of test results for analysis.

dB. Decibel, a means of expressing the ratio of two signal levels. [dB = 10 log P2/P1] Useful in RF work where people work with large gain or loss ratios.

dBc. The ratio (in dB) of a signal to the magnitude of an associated carrier signal. Useful for expressing relative levels for noise or spurious products on a signal generator's output signal.

dBm. A unit of power, dB relative to a 1 milliwatt reference. +3 dBm is 3 dB. (2x) above 1 milliwatt, or 2 milliwatts.

dBμv. Decibels relative to a 1 microvolt reference. Used in EMI work and in some parts of radio industry.

dBV. The increase or decrease in voltage independent of impedance levels.

dBW. Decibels referred to one watt.

Default Value. The parameter value for a mode or function that is assumed when no explicit value, or sometimes when a value of 0, is specified.

Defect. A failure in a circuit board caused by a process error of a faulty component.

Defect Rate. The average number of defects per board.

Delay Circuit or Line. A circuit which delays the passage of a pulse or signal from one part of a circuit to another.

Delayed Sweep. An oscilloscope function that allows you to delay the start of display for a specified time after a trigger event.

Derived Units. Units in the SI system that are derived from base units. Volts, ohms, and watts are derived from amperes and other base and derived units. Also see **Base Units.**

Digital Bandwidth. 1) For a DSO, sometimes used to describe the maximum frequency for a repetitive signal that can be accurately reproduced. Generally limited to the analog bandwidth of the vertical input amplifier.
2) Measure of highest frequency that can be captured with an oscilloscope. Sometimes used for single shot signals, sometimes used for repetitive signals, sometimes to identify the bandwidth of a DSO while in one of its digital operating modes. See Maximum Captured Frequency.

Digitally Delayed Sweep. DSO equivalent of delayed timebase in an analog oscilloscope. Delay is based on instrument's digital clock.

Distortion. Undesired changes in waveform of a signal. Harmonic distortion disturbs the original relationship between a frequency and other frequencies naturally related to it. Intermodulation Distortion (IMD) introduces new frequencies by the mixing of two or more original frequencies. Other forms of distortion are phase distortion and transient distortion.

Divide Band Architecture: Signal generator design in which low frequencies are created by dividing down from an octave that has been synthesized in a higher frequency range.

DOU. Data Output Unit. A circuit used to interface data between a measuring instrument and a recording or data storage device.

Drift. Gradual change in a value over time.

DSO. Digital Storage Oscilloscope.

Dual ADC. In a DSO, this information reveals if each channel of the DSO has its own A/D convertor. If yes, then the full sample rate is available for each channel.

Duty Cycle. The ratio of devices' on time to the total of the on and off time.

Dynamic Faults. Faults that appear only when the components on the board are interacting in sequence, at rated speed.

Dynamic Range. Maximum signal amplitude that can be displayed without distortion.

EEPROM. Electrically Erasable Programmable Read-Only Memory. An EEPROM is a memory device that provides the nonvolatile data storage characteristics of a ROM yet can be electrically erased and rewritten like a RAM device. EEPROM allows a large, yet finite, number of write operations.

Enveloping. In a DSO, the ability to build an envelope of all signal variations over time. This permits the capture of AM as well as FM signals, jitter, and spurious event too short to be captured by the time base speed used.

EPROM. Erasable Programmable Read-Only Memory. A memory device that can be erased with ultraviolet light and reprogrammed using specialized equipment.

Fault. Also see **Defect.**

Fault Coverage. The percentage of encountered faults a tester is capable of detecting.

Fault Spectrum. The distribution of total faults encountered into the different types.

Feedthrough. Plated through holes on a PCB that allow circuitry to run on either side.

Firmware. Computer programs and data that are recorded in permanent memory. See **ROM** and **EPROM.**

First Pass Yield. The percentage of boards arriving at a tester that pass the first time.

Fixed Range Function. A special function, in which attenuator switching is inhibited, and amplitude is controlled electronically. Insures monotonic, transient-free control over a limited amplitude range. Used for receiver squelch testing.
Fixture. See **test fixture.**

Fixture Verification. A capability of a tester to assure that spring pins are making good contact with the board under test.

Glossary of Terms

Flatness. A measure of output level variation for an ac voltage source as frequency is varied. Flatness limits are normally specified as a ratio (%) to nominal output level at a reference frequency.

Floor Error. A contribution to measurement or source uncertainty that is independent of reading or output setting. In uncertainty specifications, floor error is often combined with fixed range errors and expressed in units such as microvolts or counts of the least significant digit. Also see **Offset Error** and **Systematic Error.**

Four-Terminal Ohms. A method for making accurate low-resistance measurements. In the four-terminal method, the current source and voltage measurement terminals are separate. This eliminates the test lead resistance.

Frequency. The number of recurrences of a periodic phenomenon in a unit of time.

Frequency Synthesizer. Frequency generation section of modern signal generators, also sometimes sold as a stand-alone product. Produces a signal that is locked to a precision crystal reference oscillator. Gives programmable signals with crystal-controlled stability.

FSK. Frequency Shift Keying, a method of transmitting digital data over radio by shifting carrier frequency. Usually shift up in frequency for a "1", and down for a "0". Used in digital pagers, telemetry, and control signaling in radio systems.

Full Scale. The upper limit of measurement or source value for which a given uncertainty specification applies, including any "overrange". Also see **Overrange, Range**.

Functional Board Tester (FBT). A tester that measures the functionality of a PCB.

Gain Error. The portion of instrument error resulting when the slope of its response curve is not exactly 1. For example, a meter with only gain error (no offset or linearity error) will read 0V with 0V applied, but something other than 10V with 10V applied.

Gasketing. The vacuum seal between the board under test and the test fixture.

GPIB. General Purpose Interface Bus. See **IEEE-488.**

Ground Loop. Undesirable current induced when there is more than one chassis ground potential in a system of instruments. Ground loops can be minimized by connecting all instruments in a system to a single ground point.

Guard. See **Voltage Guard** and **Current Guard**.

Guarding. A measurement technique that permits an analog component on a PCB to be isolated from the effects of surrounding components.

Handshaking. A method by which data is exchanged between devices only when each device has signaled that it is ready.

Het Band. The lowest frequency range on most signal generators is created by mixing or "heterodyning" down signals that are synthesized at a higher frequency.

Hexadecimal. A base-16 number system using the symbols "0" through "9", and "A" through "F". Hexadecimal numbers are a more compact and easier to read way to represent binary number patterns. Also see **Binary**.

Horizontal (Time) Resolution. For a DSO, the minimum time duration needed to sample an incoming signal. Generally equal to the inverse of the real time sampling rate (assuming the scopes' rise time is at least that fast).

Hot Mock-up. A copy of the end product used for functionally testing PCBs. It is usually ruggedized and modified for ease of access to the UUT.

Hyperstart. An option for the Fluke 9410/9420 Systems that includes a test fixture, a test program and on-site training at time of installation. This option allows a customer to be testing boards immediately upon installation of their systems.

IEEE-488. A high-speed communications interface, often used in analog test equipment.

Incidental AM. Unwanted amplitude modulation that occurs when frequency modulating. Seldom a significant problem in modern signal generators.

Incidental FM. Unwanted frequency modulation that occurs when a signal is being amplitude modulated. Was a problem in older signal generators due to oscillator "pulling," but is rarely significant in synthesized generators.

In-Circuit Tester (ICT). A tester that measures components and connectivity of PCBs. It isolates analog components by use of guarding and digital components by back-driving.

Interface. A shared information boundary between systems.

Interface Pod. A microprocessor-specific unit used in connection with Fluke board test equipment, giving it the ability to emulate the activity of the microprocessor on the board.

Isolation. Separation of one section of a system from undesired influences of other sections.

Jitter. Instability of a signal in either its amplitude, its phase, or both.

Kernel. The nucleus or core of a computer's operating system software. For example, in the IBM PC environment, the kernel is its BIOS (Basic Input/Output System).

Life-Cycle Cost. The consideration of all elements contributing to the cost of an instrument throughout its useful life. This includes initial purchase cost, service and maintenance cost, and the cost of support equipment.

Linearity. Degree of conformity to straight-line response. For an analog to digital system such as a DMM or counter, or a digital to analog system such as a calibrator, linearity is the degree that nominally equal digital steps are equal in magnitude.

Linearity Error. Error resulting when the response curve of an instrument is not exactly a straight line. This type of error can be measured by characterizing fixed points near each end of a given range (to remove gain and offset errors), and then measuring deviations from a straight line through the characterized endpoints.

Loaded Board. A PCB with the components loaded and soldered in place.

Manufacturing Defect(s). Defects induced in PCBs by the manufacturing process. Includes shorts, missing, wrong and mis-oriented components.

Manufacturing Defect Analyzer (MDA). A relatively low cost tester optimized for detecting manufacturing defect.

Manufacturing Process Tester (MPT). A newer, more accurate name for an MDA.

Glossary of Terms

MAP (Measurement Assurance Program). A program for controlling measurement processes that provides information to ensure that the total uncertainties of measurements relative to national or other designated standards are quantified and sufficiently small to meet requirements.

Maximum Captured Frequency. Identified the highest frequency that can be captured with a DSO. Can identify the highest frequency for a DSO in its Repetitive mode, for repetitive signals, or the highest frequency that can be captured as a single shot, based on the DSO's real time sampling speed.

Maximum Single-Shot Frequency. On a DSO, the highest frequency non-repetitive event that can be accurately captured and displayed. Generally equal to approximately $^1/10$ the real-time sampling rate.

Metrology. The science of metrology is that field of knowledge concerned with measurement. The practice of metrology is all those activities which taken together result in proper measurements.

Mini-cassette. A storage medium used by Fluke board test equipment for storing test programs.

Minimum Use Specifications. Specifications computed to satisfy the calibration requirements of measurement or source device (UUT). Usually determined by a specified test uncertainty ratio between the absolute uncertainties of the UUT and its required calibration equipment. Also see **Test Uncertainty Ratio**.

Mnemonic. An abbreviated name. Examples are "pixel" for picture element, and "bit" for binary digit.

Modulation. The controlled variation of frequency, phase and/or amplitude of a carrier wave of any frequency in order to transmit a message.

Modulation Depth. Refers to amount of modulation, or "loudness" in audio terms. In FM and PM, modulation depth is determined by deviation; in AM it is determined by the percent of modulation.

Modulation Index. In FM, the ratio of Peak Deviation to Modulating Audio Frequency, i.e., at 1 kHz tone, with a deviation of 3.5 kHz, produces a modulation index of 3.5. Modulation index is important in mathematical analysis of modulated signals.

Multidrop. A communication configuration whereby several instruments share a common communications link.

Multidrop Control Code. Any of the control codes sent by the host to implement the multidrop communication protocol.

Mylar. Film. A photo representation of a PCB on a Mylar sheet. Can be either a positive or negative.

NEMA. National Electrical Manufacturers Association. Publishers of various standards, including the NEMA 12 standard that describes dust-proof and water-resistant enclosures.

Net. Common connection of two or more components on a schematic diagram or on a PCB.

Net List. A listing of the nets and components connected to them on a PCB.

New Volt. On January 1, 1990, the world adopted a new worldwide standard of voltage. The change from the old standards was made so everyone will have the same volt, and instruments calibrated in one country will measure accurately in another. Each country adjusted its volt by the amount needed to make it correspond to the SI volt.

Node. A terminal of any branch of a network, or a terminal common to two or more branches on a printed circuit board. Also called a junction point, branch point, or vertex.

Noise. Any signal that does not contain useful information.

Nonvolatile Memory. An electronic memory that retains its contents when power is turned off.

Normal Mode Noise. Noise that appears between the input or output terminals of a device. Also see **Common Mode Noise**.

Normal Mode Rejection. Ability to measure the dc component of a signal which contains both ac and dc.

Nyquist Rate: Theoretical minimum number of samples needed to extract accurate data from a continuous, band-limited signal. Generally equal to half the real time sampling rate, for non-repetitive signals, (yielding 2 samples per period on the incoming signal) although for DSOs, 10 sample per period is more practical.

Offset. The ability of an instrument to compensate for any offset voltage in the input signal, without resorting to AC input coupling. In a DSO this allows the maximum resolution of the A/D circuitry to be employed, the offset in the input signal measured, all without introducing the distortion inherent in AC coupled circuits.

Offset Error. The reading reported by a measuring instrument connected to an actual input value of zero, or the actual output of a source instrument set to zero. Offset error is similar in concept to floor error, except that by common usage offset error refers to the actual fixed error while floor error refers to the fixed portion of an uncertainty specification. Also see **Floor Error** and **Systematic Error**.

Orientation. The desired placement of a board under test on the fixture.

Overrange. An extension to the nominal upper limit of a measurement or source device for which a given uncertainty specification applies, often given in percent. For example, the uncertainty specification for the 10V range of an instrument with "100% overrange" applies up to 20V. Also see **Range**, **Scale**.

Pad. The area on a PCB where the lead of a component connects.

Padmaster. The film or Mylar of a PCB containing only the pads.

Parallax. An optical effect that occurs when viewing two objects at different distances from different angles.

Parameter. An adjustable operating feature. Examples of parameters include baud rate, cursor type, and light or dark background.

Parity. A method of error detection that uses one extra bit for each unit of information (such as a byte). The parity bit is set to 1 or 0 so that the total number of 1's in the byte, together with the parity bit, is even for even parity or odd for odd parity.

Period. The time required for one complete cycle of a regular, repeating series of events.

Phase Modulation. Method for modulating a signal by varying phase of carrier signal in response to an analog or, more commonly, a digital modulating signal.

Glossary of Terms

Phase Noise. Short-term, random phase variations of an RF signal, a result of electrical noise in the signal generator's circuits. Expressed in dBc/Hz, which is noise density in a 1 Hz equivalent bandwidth, relative to the carrier amplitude.

Pin. A spring-loaded connector in a bed-of-nails fixture that makes contact with the board under test.

Pin-Field. The physical area from which the board under test can be probed. This is a subset of the total area of the board.

Pin Verification. A preliminary test to make sure all tester pins are in contact with the UUT before the actual test begins. This feature is designed to be used with loaded-board tests. It is based on the assumption that, from any given point on a loaded board, there is a path to either V cc or ground.

Pixel. A mnemonic for picture element, an individual dot on a display screen.

Points. Same as **Channels.**

Port. A connection point used for data transfer. See **Interface**.

Precision. The degree of agreement among independent measurements of a quantity under specified conditions. The precision of a measurement process is its coherence or repeatability. Note that while precision is necessary for accuracy, it does not imply it.

Predictability. A measure of what is known of the time-behavior of a device. A documented drift rate with understood characteristics (e.g., linear, exponential) can be highly predictable.

Printed Circuit Board (PCB). Photo-etched circuitry on a copper clad board.

Process Metrology. A statistics-based method for controlling the accuracy of measurements actually made, in contrast to the accuracy of the instruments used to make the measurements. Process metrology uses check standards and statistical process control (SPC) to maintain measurement processes in statistical control, and uses measurements made on products of the measurement system to verify that the processes are properly controlled. Major benefits include continuous evidence that good measurements are being made, increased process up-time due to the fact that instruments are not recalled for periodic recalibration, and MIL-STD-45662A traceability without the need for 4:1 Test Uncertainty Ratios.

Program. Any meaningful sequence of computer instructions that causes a system to accomplish a task.

PROM. Programmable Read-Only Memory, a memory device that can be programmed using specialized equipment.

Prompt. A displayed message that guides the operator to the next step.

Protocol. A set of rules for exchange of information between systems or devices.

PSK. Phase Shift Keying, a method for transmitting digital data over radio by shifting carrier phase.

QPSK. Digital modulation with four phase states.

RAM. Random access memory. Through common usage, the term has come to mean the high-speed volatile semiconductor memory that is normally used for system and user memory. It is memory, both readable and writable, used to store and recall information.

Random Error. Any error which varies in an unpredictable manner as successive measurements of the same quantity are made under effectively identical conditions. Also see **Systematic Error.**

Random Sampling. A form of Repetitive Sampling that takes samples of successive periods of an incoming repetitive signal at fixed intervals. In a DSO, these samples are stored in memory, and used to reconstruct a lower frequency replica of the incoming signal.

Range. Stated upper limits of measurement or source values for which given uncertainty specifications apply. Also see **Overrange, Scale**.

Raster. The scanning pattern of an electron beam on a CRT display. A raster display uses the same scan pattern all the time, forming images by turning the beam on and off at appropriate times.

RCU. Remote Control Unit. A circuit capable of operating an instrument's function and range controls by use of remote control signals.

Reading Rate. The speed at which a measurement system can take measurements.

Real Time. Pertaining to the actual time during which physical events take place.

Real Time Sampling. Takes a sequential series of samples from the incoming signal, even if they are not repetitive, as they occurred in time.

Receiver. The part of the fixturing system that accepts the test fixture and mates to the tester electronics using cabling.

Receptacle. The sleeve which is pressed into the test fixture into which the spring pin is placed.

Reject Rate. The percentage of PCBs of a given type that contain one or more defects.

Relative Accuracy. See **Relative Uncertainty**.

Relative Uncertainty. Measurement uncertainty that includes only the error contributions from the measuring or source instrument. Also see **Absolute Uncertainty**.

Repeatability. See **Precision.**

Repetitive (or Time-equivalent) Sampling. Takes a series of samples from successive periods in a repetitive signal. May be either "sequential" or "random". In a DSO, these samples are then stored and used to reconstruct the incoming signal.

Residual FM. A measure of FM noise (short-term instabilities) of a signal generator's output, as measured with an FM modulation meter. It is a key specification when a generator is used for testing FM radios.

Resolution. The smallest increment in value that can be detected and displayed by a measurement system or displayed and generated by a calibration source.

Rise Time. The time required for the leading edge of a pulse to rise from 10% to 90% of its final value. For an oscilloscope, it equals .25 ÷ analog bandwidth.

RMS (Root-Mean-Square). For voltage or current, the value assigned to a level equal to that of a direct voltage (current) producing the same power dissipation through a pure resistance. "RMS" is also applied to many other parameters.

Glossary of Terms

Roll Mode. The ability of a DSO to update its display memory continuously, as new data points are captured. This is used in the very slow timebase speeds that most DSOs are capable of, and permit a continuous observation of signal changes. The behavior is often compared to that of a paper and pen recorder.

ROM. Read-only memory. A memory used for permanently recorded computer programs and data.

RS-232C. An EIA-defined standard for a serial communications interface commonly used between computers, terminals, and modems.

Sampling. The process of obtaining a sequence of values of a signal. Sampling may be at regular or intermittent intervals.

Sampling Rate. The number of times that a particular data channel is sampled by a commutator in one second.

Scale. See **Full Scale.**

Scale Error. See **Gain Error.**

Serial Data. Information transmitted one bit at a time at a predefined baud rate.

Serial Port. A physical connector for transmitting and receiving serial data.

Sensitivity. In commercial FM mobile radio: the minimum input signal to a receiver that will produce a 12 dB SINAD.

Sequential Sampling. A form of Repetitive Sampling that takes a single sample of the incoming repetitive signal as each new period of the signal triggers the sampling device, with each sample occurring at progressively increasing time intervals beyond the trigger point. In a DSO, these are stored in memory, and used to reconstruct a lower frequency replica of the incoming signal.

Settling Time. The time interval, following the initiation of a specified stimulus to a system, required for a specified variable to enter and remain within a narrow band, centered on the final value of the variable.

Short. Any connection having relatively low resistance or impedance: an intentional interconnection of terminals for test or calibration purposes, or any resistance between two points below a preselected threshold.

Siemens. Unit of conductance (S), formerly mho, the reciprocal of resistance.

Signal Conditioning. To process the form or mode of a signal so as to make it intelligible to, or compatible with, a given device, including such manipulation as pulse shaping, pulse clipping, digitizing and linearizing.

Signal/Noise Ratio. Ratio of the magnitude of the signal to that of the noise (often expressed in decibels).

SINAD. The Signal plus Noise and Distortion to Noise and Distortion ratio, expressed in dB, measured at the output of a radio receiver with an audio distortion analyzer. Most commercial radio tests are run at 12 dB SINAD. If distortion effects are ignored, it is identical SNR (signal-to-noise ratio).

Slew Rate. The maximum rate of change of the output voltage of an amplifier operated within its linear region.

Software. Computer programs and data recorded in erasable memory. Also see **Firmware**.

Spectral Purity. A general term used to refer to the cleanliness of an RF signal – its freedom from contamination by noise and spurious signals.

Spring Pin. Spring Probe. Probe. A pin, using the pressure of a spring, used to electrically contact the test point or node on the board under test.

Spurious. Unwanted discrete frequencies present on the output of a signal generator, measured relative to carrier level in dBc. Usually this term is taken to mean the "non-harmonic" spurious specification for a signal generator. In the more general sense, spurious refers to all undesired, discrete (non-random) outputs from a signal generator, including additional harmonics, sub-harmonics, and line-related products.

SSB. Single Sideband, a form of radio used in long-distance military and marine transmissions. It is a modified amplitude modulation, in which the carrier and one sideband have been suppressed to achieve high efficiency.

SSB Phase Noise. A plot of the phase noise spectrum of one side of an RF signal. (Normally the two sides are symmetrical.)

Stability. A measure of the freedom from drift in value over time and over changes in other variables such as temperature. Note that stability is not the same as uncertainty.

Standard Cell. A primary cell which serves as a standard of voltage.

Stop on Difference. Permits an oscilloscope to test a new waveform against a reference waveform in the scope's memory. Upon violation, new acquisitions are stopped. **Save on difference** is similar to the previous function, with the exception that the violating waveform is stored in a user assigned memory. Acquisition continues.

Support Pads. Hard rubber stops bonded to the top of the test fixture to support the board under test to maintain flatness when under vacuum.

Sweep. The crossing of a range of values of a quantity for the purpose of delineating, sampling, or controlling another quantity.

Sweep Delay. The time between the application of a pulse to the sweep-trigger input of an oscilloscope and the start of the sweep.

Switching System. The mechanical or electronic switching used to connect the electrical points on the board under test to the tester's electronics.

Synchronous Data. Information transmitted at predictable times, for example in response to a command. Synchronous data may be in a predetermined block size, and may include a synchronizing clock signal for use by the receiving system. Also see **Asynchronous Data**.

System. An interconnection of instruments or other devices.

Systematic Error. Any error which remains constant or varies in a predictable manner as successive measurements of the same quantity are made under effectively identical conditions. Note that a known systematic error can be compensated for with a correction, whereas a random error cannot. Also see **Random Error.**

Temperature Coefficient. A factor used to calculate the change in indication or output of an instrument with changes in temperature. Uncompensated changes in temperature contribute to instrument uncertainty by an amount determined by the temperature coefficient.

Test Fixture. LA surface on which spring pins are strategically located to make electrical contact with the board under test.

Test Fixture Kit. The test fixture, designed for a specific receiver, that contains all the parts, but that has not yet been assembled into a working test fixture.

Test Head. Same as **Test Fixture.**

Glossary of Terms

Test Head Receiver. Same as **Receiver**

Test Station. Any tester whether manual or automated.

Test Station Controller. Same as **Controller.**

Test Uncertainty Ratio. For calibration, the ratio between the absolute uncertainties of a UUT and of the equipment being used to calibrate it. For measurement, the ratio between the specified tolerance of a measurement parameter and the uncertainty of the instrument, process, and traceability used to measure it.

Thermal emf. A voltage generated when two dissimilar metals joined together are heated. This is often an error source in calibration and measurement processes when lower quality terminals and connections are used.

Threshold. A resistance level used in performing shorts/continuity test on an MDA. Points on a PCB with a resistance between them that is less than or equal to this level are considered to be connected together. Points having resistance between them that is greater than this level are considered isolated form each other.

Time Base. A voltage generated by the sweep circuit of a cathode ray tube indicator. Its wave shape is such that the trace is either linear with respect to time, or if nonlinear, is still at a known timing.

Tooling. A method of aligning parts.

Tooling Holes. The holes on a PCB, used to mate with the tooling pins on the test fixture, to align the PCB with the test fixture.

Tooling Pins. The pins on the fixture, used to mate with the tooling holes on the PCB, to align the PCB with the test fixture.

Touch Cell. An individual physical switch on the touch panel.

Touchkey. A group of one or more touch cells in conjunction with a visual target that work together as a command entry point for the user. All touch cells in the group are defined by the programmer as a touchkey, so the program recognizes an input from any of the touch cells as the same entry.

Touchkey Programming. All screen-dependent attributes and controls associated with the use of the touch panel and targets.

Touch Panel. The transparent overlay residing in front of the display. The touch panel detects the location of a physical touch against areas of the display.

Trace. The conductive copper material remaining on the PCB after etching that provides interconnection of components.

Traceability. The ability to relate individual measurement results to legally defined national standards through an unbroken chain of comparisons. Traceability requires evidence produced on a continuing basis, such as calibration records, that the measurement process is producing results for which the total measurement uncertainty relative to national standards is quantified.

Transfer Error. Error induced by the process of comparing one standard or instrument with another.

Transfer Standard. Any standard used to intercompare one measurement or source device with another. Note that a transfer standard needs only to be stable for the duration of the transfer. It does not need an assigned value.

Trigger. To cause, by means of one circuit, action to start in another circuit, which then functions for a certain length of time under its own control. A pulse that starts an action.

Trigger Level. The instantaneous level of a triggering signal at which a trigger is to be generated. Also the name of the control which selects the level.

True RMS. A circuit used for measuring ac signals to obtain the effective heating value. The rms value of an ac waveform is equivalent to the dc value which would produce the same heating in a purely resistive load. A True RMS circuit makes accurate measurements even if the waveform is nonsinusoidal.

TV trig. The ability of an oscilloscope's trigger circuits to separate the Synchronization signals from the video information, in a composite TV signal.

Uncertainty. The range of values, usually centered on the indicated or requested value, within which the true, accepted, or consensus value is expected to lie with stated probability or confidence. Fluke uses 99% confidence limits unless other limits are specified. Uncertainty is a quantification of inaccuracy.

Unit Under Test (UUT). The PCB being tested.

User Nomenclature. The terms customers use to refer to points on PCBs.

Verification. The comparison of a measurement or source device (UUT) with a measurement or source device of known and lesser uncertainty, to report variation from required performance. Verification does not include adjustment or reassignment of values to UUT, and is often done to determine whether adjustment is necessary. Also see **Calibration.**

Vert Resolution. In a DSO, this value indicates how many discrete voltage steps are available to describe the signal.

Vertical Resolution. Minimum change in amplitude that can be detected and captured. Measured in bits, percent of full scale, or absolute.

Video Modulation. Wideband (several Megahertz) amplitude modulation, suitable for simulating television signals.

Volatile Memory. In computers, any memory which can return information only as long as energizing power is applied. The opposite of nonvolatile memory.

Voltage Guard. A floating shield around voltage measurement circuitry inside an instrument. The voltage guard provides a low-impedance path to ground for common-mode noise and ground currents, thereby eliminating errors introduced by such interference.

Wire List. The list of points on the board under test that are to be connected to test points on the fixture. Usually the points on the board are listed using their nomenclature (e.g. U33 pin 5) and the points on the test fixture are listed sequentially.

Wiring Conventions. For a receiver, a description of the specific points on the receiver interface that are actually wired up. Some receivers use only some of the total available points.

Yield. The percentage of PCBs that contain zero defects.

Zero Error. See **Offset Error.**

Glossary of Terms

Abbreviations & Symbols

The following lists are taken from ANSI Y1.1-1972 and ANSI/IEEE Std 260-1978, but they also include common abbreviations used by Fluke that are not part of either standard. In cases where a term has both an abbreviation and a letter symbol, each is identified.

A

A	ampere (symbol)
ac	alternating current
ac/dc	alternating and/or direct current
a/d	analog-to-digital
adc	analog-to-digital converter
ADP	automatic data processing
adrs	address
af	audio frequency
afc	automatic frequency control
agc	automatic gain control
Ah	ampere-hour (symbol)
alc	automatic level control
alu	arithmetic and logic unit
am	amplitude modulation
amp	ampere (abbreviation)
amp hr	ampere-hour (abbreviation)
ampl	amplifier
AND	AND logic function
ANSI	American National Standards Institute
approx	approximate
ASCII	American Standard Code for Information Interchange
assy	assembly
ATE	automatic test equipment
ATPG	Automatic Test Program Generator
atten	attenuation
auto	automatic
aux	auxiliary
avc	automatic volume control
AWG	American Wire Gauge

B

b	bit
B	base (of transistor)
B	bel
B	byte
bat	battery (electrical)
bcd	binary-coded decimal
Bd	baud
bfo	beat-frequency oscillator
b/i	bits per inch (symbol)
bit	binary digit
bpi	bits per inch (abbreviation)
bps	bits per second (abbreviation)
b/s	bits per second (symbol)
BTU	British thermal unit
bw	bandwidth
bwo	backward-wave oscillator

C

c	centi (prefix, 10^{-2})
c	cycle
C	collector (of transistor)
°C	(degrees) Celsius
CAD	computer aided design
cal	calibrate
cap	capacitor
cath	cathode
CBT	Combinational Board Tester
ccw	counterclockwise
cfm	cubic foot per minute (abbreviation)
cfs	cubic foot per second (abbreviation)
cg	centigram
cgs	centimeter-gram-second
chan	channel
chgr	charger
ckt	circuit
clk	clock
cm	centimeter
cm^3	cubic centimeter
cmd	command
cmil	circular mil
CMOS	complementary metal-oxide semiconductor
cmr	common mode rejection
cmrr	common mode rejection ratio
coax	coaxial
coef	coefficient
com	common
conn	connector
cont	control
cpi	characters per inch
cps	characters per second
CPU	central processing unit
crt	cathode-ray tube
c/s	cycle(s) per sec (Hz is now preferred)
CSA	Canadian Standards Association
CTL	complementary transistor logic
cu	cubic
cu ft	cubic foot (abbreviation)
cu in	cubic inch (abbreviation)
cu m	cubic meter (abbreviation)
cu yd	cubic yard (abbreviation
cw	clockwise
cw	continuous wave

D

d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dBm	decibels above or below 1 milliwatt
dBv	decibels above or below 1 volt
dBW	decibels above or below 1 watt
dc	direct current
dc/ac	direct and/or alternating current
DCTL	direct-coupled transistor logic
deg	degree(s) (abbreviation)
dgtl	digital
diel	dielectric
diff	differential
DIP	dual in-line package
DMA	direct memory access
DMM	digital multimeter
dn	down
dp	double-pole
dpdt	double-pole double-throw
dpst	double-pole single-throw
DSO	digital storage oscilloscopes
dspl	display
dt	double-throw
DTB	delayed timebase
DTL	diode transistor logic
dty cy	duty cycle
dut	device under test
dvm	digital voltmeter
°	degree (temperature) (symbol)

E

E	emitter (electron device)
ECL	emitter-coupled logic
EDP	electronic data processing
EEPROM	Electrically-Erasable Programmable Read-Only Memory
EEROM	Electrically-Erasable Read-Only Memory
ef	emitter follower
EIA	Electronics Industries Association
elec	electric
emf	electromotive force
emi	electromagnetic interference
EPROM	Erasable Erogrammable Read-Only Memory
ext	external

F

f	force
F	farad
°F	(degrees) Fahrenheit
FBT	Functional Board Tester
fc	footcandle
FCS	Fluke Cooperative Service
fdm	frequency division multiplex
FET	field-effect transistor
ff	flip-flop
fL	footlambert
fltr	filter
fm	frequency modulation
FM	Factory Mutual Research Corp.
fpm	foot (feet) per minute (abbreviation)
fps	foot (feet) per second (abbreviation)
freq	frequency
FS	Federal Specification
FSN	Federal Stock Number
ft	foot (feet)
ft lb	foot pound force (abbreviation)
ft•lbf	foot pound force (symbol)
ft/min	foot per minute (symbol)

Glossary of Terms

ft/s	foot per second (symbol)
ft^{2}	square foot (symbol)
ft^{3}	cubic foot (symbol)
ft^{3}/min	cubic foot per minute (symbol)
ft^{3}/s	cubic foot per second (symbol)
fw	full wave

G

g	gram
g	gravity force
G	giga (prefix, 10^{9})
gal	gallon
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
GPIB	general-purpose interface bus

H

h	hour (symbol)
H	henry
hd	heavy duty
het	heterodyne
hex	hexadecimal
hf	high frequency
hfo	high-frequency oscillator
hp	horsepower
hr	hour (abbreviation)
hv	high voltage
hw	half wave
Hz	hertz (cycle(s) per second)

I

IC	integrated circuit
ICT	In-Circuit Tester
IEC	integrated electronic component
IEEE	Institute of Electrical and Electronic Engineers
in	inch
in^{2}	square inch (symbol)
in^{3}	cubic inches (symbol)
in lb	inch-pound
in/s	inch per second (symbol)
instr	instrument
intl	internal
i/o	input-output
ips	inch per second (abbreviation)

J

J	joule
JFET	junction field-effect transistor

K

k	kilo (10^{3}, unit prefix)
K	kilo (2^{10}, number suffix)
K	kelvin
Kb	kilobit
KB	kilobyte
kBd	kilobaud
kg	kilogram
kHz	kilohertz
km	kilometer
kV	kilovolt
kVA	kilovolt-ampere
kW	kilowatt
kWh	kilowatt hour
kΩ	kilohm

L

L	liter (preferred spelling)
L	lambert
lab	laboratory
lb	pound
lbf	pound force
LCD	liquid-crystal display
LED	light-emitting diode
lf	low frequency
log	logarithm
LSB	least-significant bit
LSD	least-significant digit
LSI	large-scale integration

M

m	meter
m	milli (prefix, 10^{-3})
M	mega (prefix, 10^{6})
mA	milliampere
max	maximum
Mb	megabit
MB	megabyte
MDA	Manufacturing Defects Analyzer
mf	medium frequency
mg	milligram
mH	millihenry
MHz	megahertz
mi	mile
mi/h	mile per hour (symbol)
MIL-STD	military standard
min	minimum
min	minute (time)
mL	milliliter
mm	millimeter
mo	month
modem	modulator-demodulator
MOS	metal-oxide semiconductor
MOV	metal-oxide varistor
mph	mile per hour (abbreviation)
MPT	Manufacturing Process Tester
MPU	microprocessor unit
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MSHA	Mine Safety & Health Administration, U.S. Department of Labor
MSI	medium-scale integration
MTB	main timebase
mux	multiplex
mv	multivibrator
mV	millivolt
MV	megavolt
MV A	megavolt-ampere
mW	milliwatt
MW	megawatt
m^{2}	square meter (symbol)
m^{3}	cubic meter (symbol)
m^{3}/s	cubic meter per second (symbol)
mΩ	milliohm
MΩ	megohm
µ or u	micro (prefix, 10^{-6})
µA	microampere
µF	microfarad
µg	microgram
µH	microhenry
µm	micrometer (micron)
µP	microprocessor
µs	microsecond
µV	microvolt
µW	microwatt

N

n	nano (prefix, 10^{-9})
nA	nanoampere
NAND	NOT AND logic function
NBS	National Bureau of Standards
NC	normally closed
neg	negative
nF	nanofarad
nH	nanohenry
NIST	National Institute of Standards & Technology
nm	nanometer
no	number
NO	normally open
NOR	NOT OR logic function
npn	negative-positive-negative (transistor)
NRC	National Replacement Code
ns	nanoseconds
nS	nanosiemens
NSN	National Stock Number

O

OEM	original equipment manufacturer
OR	OR logic function
osc	oscillator
oz	ounce
Ω	ohm

P

p	pico (prefix, 10^{-12})
pA	picoampere
pca	printed circuit assembly (Fluke prefers pca to pcb)
pcb	printed circuit board
pcm	pulse-code modulation
pdl	poundal

Glossary of Terms

pF	picofarad
pk	peak
PLL	phase-locked loop
pn	part number
pnp	positive-negative-positive
PO	purchase order
pos	positive
pot	potentiometer
p-p	peak to peak
ppm	parts per million
ppm	pulse-position modulation
pps	pulses per second
preamp	preamplifier
PROM	Programmable Read-Only Memory
ps	picosecond
pt	pint
PTI	portable test instrument
ptm	pulse-time modulation
pW	picowatt
pwm	pulse-width modulation
pwr	power
pwr sply	power supply

Q

QA	quality assurance
QC	quality control
qt	quart

R

R&D	research and development
rad	radian (plane angle) (symbol)
rad	radius
RAM	Random-Access Memory
RC	resistance-capacitance
rf	radio frequency
rfi	radio-frequency interference
rh	relative humidity
RL	resistance-inductance
RLC	resistance-inductance-capacitance
r/min	revolution per minute (symbol)
RMM	Read-Mainly Memory
rms	root mean square
ROM	Read-Only Memory
rpm	revolutions per minute (abbreviation)
rps	revolution per second (abbreviation)
RTD	resistance temperature detector
RTL	resistor-transistor logic

S

s	second (time) (symbol)
S	siemens
sb	sideband
sbc	single-board computer
SCR	silicon-controlled rectifier
SCS	silicon-controlled switch
sec	second (time) (abbreviation)
sin	sine
snr	signal-to-noise ratio
SPC	statistical process control
spdt	single-pole double-throw
spec	specification
spst	single-pole single-throw
sq ft	square foot (abbreviation)
sq in	square inch (abbreviation)
sq yd	square yard (abbreviation)
ssb	single sideband
SSI	small-scale integration
stby	standby
std	standard
sw	shortwave
swp	sweep
swr	standing-wave ratio
sync	synchronize

T

tan	tangent
tc	thermocouple
tc	time constant
TCS	touch control screen
TCXO	temperature-controlled crystal oscillator
thd	total harmonic distortion
TTL	transistor-transistor logic
tty	teletypewriter
tvi	television interference

U

UART	universal asynchronous receiver transmitter
uhf	ultrahigh frequency
UL	Underwriter Laboratories Inc.
UUT	unit under test
µ or u	micro (prefix, 10^{-6})

V

V	volt
VA	volt-ampere
vco	voltage-controlled oscillator
VDE	Verband Deutscher Elektrotechniker
VDT	video-display terminal
vfo	variable-frequency oscillator
vhf	very high frequency
vlf	very low frequency
vm	voltmeter
vom	volt-ohm milliammeter
vs	versus
vswr	voltage standing wave ratio
vtvm	vacuum tube voltmeter

W

W	watt
wl	wavelength

X

xfmr	transformer
xmtr	transmitter
xstr	transistor
xtal	crystal

Y

yd	yard
yd^2	square yard
yd^3	cubic yard
yr	year

Glossary of Terms

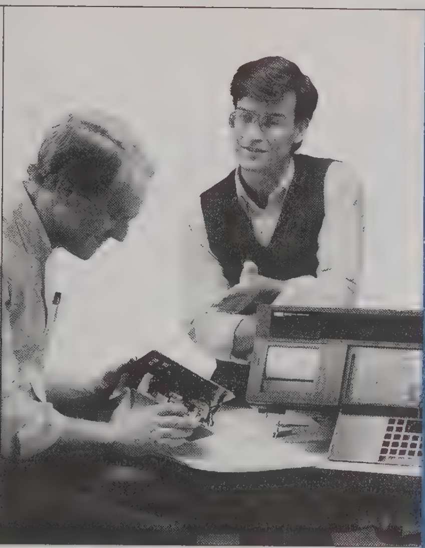
Symbols for Units of Measure

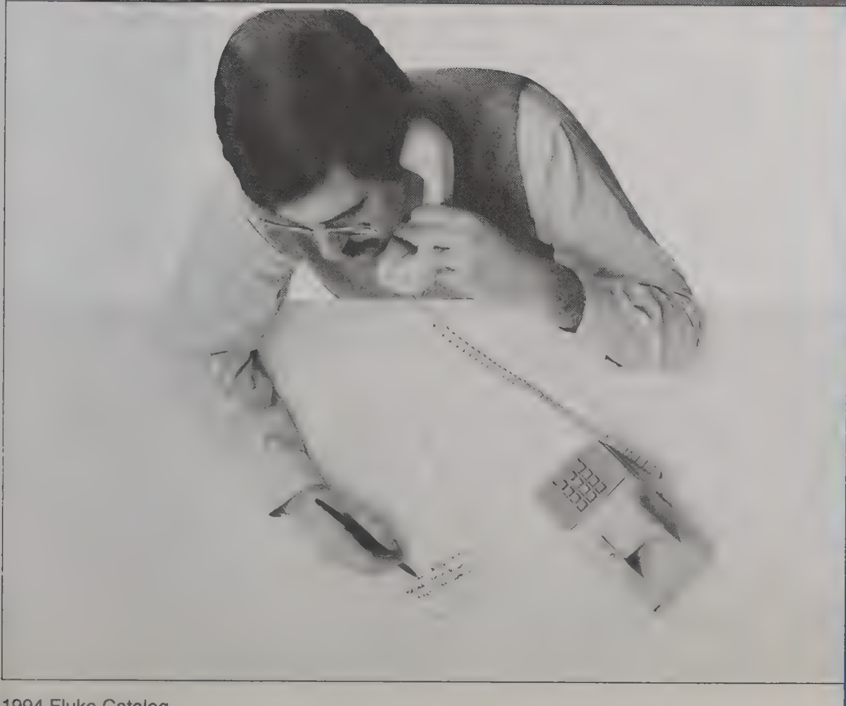
Physical	Unit of Measure	Unit Symbol
Length	meter	m
Weight	gram	g
Time	second	s
Voltage	volt	V
Electric Current	ampere	A
Resistance	ohm	Ω
Conductance	siemens	S
Inductance	henry	H
Capacitance	farad	F
Frequency	hertz	Hz
Power	watt	W
Temperature	degree	°F or °C or K
Energy, Qty of Heat	joule	J
Force	newton	N
Pressure, Stress	pascal	Pa

Common Conversions

To Convert	In To	Multiply By
centimeters	inches	0.3937
centimeters	feet	3.281×10^{-2}
centimeters	meters	0.01
grams	ounces	0.03527
kilograms	pounds	2.2046
inches	centimeters	2.540
feet	centimeters	30.48
feet	meters	0.3048
ounces	grams	28.3495
pounds	kilograms	0.4536
yards	meters	.9144
temp (°C) +17.78	temp (°F)	1.8
temp (°F) -32	temp (°C)	5/9

Ordering Information





Ordering Fluke products is as easy and convenient as picking up the phone. Fluke Sales Offices, Representatives and Authorized Industrial Distributors are located worldwide to provide you with immediate sales assistance, on your local level. For details from delivery and terms, to technical information regarding the suitability of a particular product for a specific application, give us a call.

Working with Fluke Page 410
Power Cord Configurations Page 410
Education Support Programs Page 411
Technical Literature Page 412
U.S. Sales & Service Page 414
International Sales Page 416
International Service Page 419
Authorized U.S. Distributors Page 421

Working With Fluke

Fluke's sales and service organization is built around one single promise: To give you, our customer, an extra measure of value in everything we do for you. The large number of convenient Fluke sales offices, technical service centers, distributors and representatives around the world is a reflection of that commitment. You can depend on them for quick, professional assistance regarding applications, specifications, pricing, availability, quotations, and shipping methods. See the Call Guide on the inside back cover of this catalog for instant reference on information and assistance on specific areas of interest.

Fluke and Philips Warranties

Fluke and Philips products are covered by limited warranties. Full warranty details are included with each product shipped from the factory.

Product Changes

Although product information and illustrations in this catalog were current at the time it was approved for printing, John Fluke Mfg. Co., Inc., in a continuing effort to offer excellent products at a fair value, reserves the right to change specifications, designs, and models without notice.

Calibration Documentation

These levels of calibration documentation are available for instruments shipped from the factory:

1. **Statement of Calibration Practices**
   For every serialized, non-distributor Fluke product, Fluke automatically provides a **Statement of Calibration Practices** free of charge. This document states that the instrument was calibrated with standards that are traceable to the National Institute of Standards and Technology (NIST) in accordance with the requirements of MIL-STD-45662A.
   Upon request at the time of order, a Statement of Calibration Practices can be provided for distributor products. Statements of Calibration Practices are supplied automatically and free of charge for most Philips products, too.
2. **Certificate of Calibration (Traceable to NIST)**
   At the customer's request, traceability to NIST for an individual instrument can be established at the factory. As evidence of traceability, a MIL-STD-45662A **Report of Calibration**, a calibration label indicating date of calibration, a calibration seal to prevent tampering and a printout of outgoing readings are provided.
   These items are provided free of charge for model numbers 5700A, 5725A, 742A-xK, 792A, 732B with 000 or 100 option and 5790A. For all other serialized, non-distributor products, including Philips, the fee is 90% of the CSS one-time standard calibration price.
   If a customer decides after receipt of the product that a Certificate of Calibration is needed, the product must be returned to the factory or a local service lab for traceability to be established. The charge is the one-time standard calibration price. There is an additional charge for a printout of the test data in these cases.

Power Cords

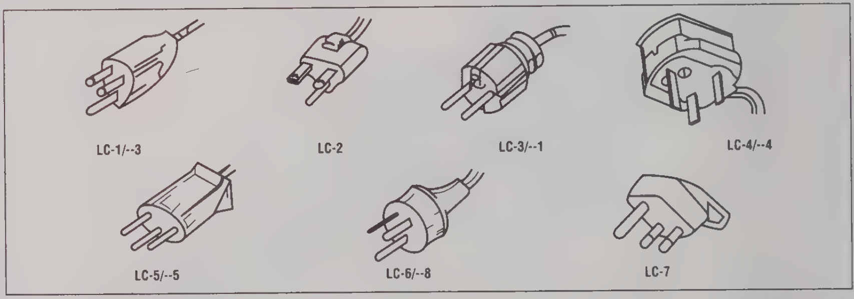
Fluke and Philips instruments are fitted with one of the power cord and plug options shown below and are wired for the voltage indicated. The power cord supplied with your instrument is the one commonly used in the country where the instrument will be delivered.

If you require a power cord and plug other than the one listed below for the country where the instrument will be delivered, specify that power cord and plug when you order.

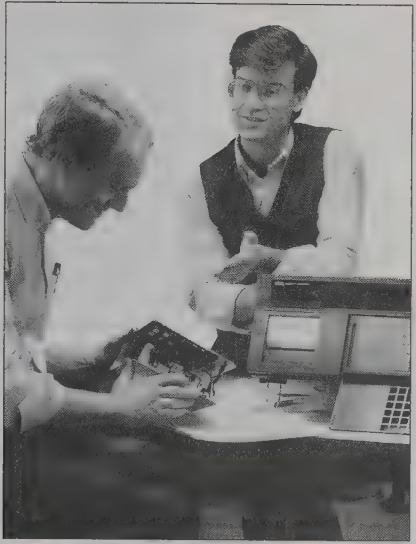
		Fluke	Philips	
			Product Category 1*	**Product Category 2****
North America	120V/15A	Option LC-1	/--3	Specify Country of destination on order
North American	240V/15A	Option LC-2		
Universal Euro	220V/16A	Option LC-3	/--1	
United Kingdom	240V/13A	Option LC-4	/--4	
Switzerland	220V/10A	Option LC-5	/--5	
Australia	240V/10A	Option LC-6	/--8	
South African	240V/5A	Option LC-7	Ask for LC-7	

* *Final digit in model number format PM----/--- for Philips Category 1 Products including Oscilloscopes, Multimeters, Recorders, and Logic Analyzers*

** *Philips Category 2 Products including Logic Analyzers, Signal Sources, Pulse Generators, Pattern Generators, and Counters*



Education Support Programs



Education Programs

Educational institutions face a tremendous challenge training tomorrow's scientists, engineers and technicians. Continuous growth in technology along with perennial budgetary constraints make the educator's job of defining an electronic curriculum, choosing the right equipment and keeping that equipment in good working order, a difficult task.

For many years Fluke has been working with educators in facing this important obligation. Fluke's Educational Support Programs are centered around a broad array of rugged, high performance instruments, a worldwide network of service and support, a series of comprehensive training materials, all at competitive prices.

Product Reliability

Fluke is recognized in the electronics industry as a premier supplier of high performance industrial-grade test instrumentation, designed and built strong enough to take the toughest abuse. We recognize that a test instrument's application ranges from the laboratory to the production floor to remote field service sites, and that users range from the highly skilled test engineer to the first-time technical trainee. Therefore, we design and build our instrumentation to be intuitively easy to use and able to withstand both physical and electrical misuse. Most of our instruments meet or exceed the safety specifications outlined by UL, CSA and the European VDE. And our MTTF (Mean Time To Failure) specs attest to our rigorous design and Quality Control standards. In support of these claims for reliability, all of our instruments are backed by one-, two- or three-year warranties.

Inherent quality and reliability pays big dividends in the classroom, where students subject equipment to heavy use, and sometimes, misuse. Where budgets for equipment maintenance, repair and calibration are limited, rugged, reliable instruments that keep on working can make a difference in today's full curriculums.

Product Breadth

Today's electronic education ranges from basic electrical theory to advanced electronics research. Fluke offers a broad array of instrumentation to meet these classroom and laboratory needs, all offering exceptional value.

Our products include real-time (analog) and storage oscilloscopes (analog and digital), handheld and bench digital multimeters, frequency counters and counter/timers, function generators, digital testers, component testers (RCL Meters) and data acquisition equipment.

Of particular interest to those educators moving their students from the analog into the digital world are our oscilloscopes and DMMs that combine both analog and digital capability. Using both measurement modes, one gains a strong understanding for the vital aspects of the growing digital domain.

Today's electronic world increasingly requires that instruments and computers "talk" to each other via GPIB/IEEE-488* or RS-232C links. The practical teaching of such concepts has been hampered until now by the complexity and high cost of such instruments and systems. Today, however, significant changes have made such teaching more practical and affordable. Fluke offers the broadest array of low-cost "building blocks" for PC-based IEEE-488 test systems available from any supplier in the world.

These building blocks include test instrumentation software, IEEE-488 cards, modular interconnect switches (System 21), digital oscilloscopes, digital multimeters, counters, function generators, logic analyzers, microprocessor testers, data acquisition devices and more.

Whether your curriculum covers basic electronics or IEEE-488 systems, your Fluke sales engineer can work with you, defining the equipment that best meets your needs.

Worldwide Support

When you choose a test equipment vendor, the product is just the first step. Fluke understands that selecting a vendor who backs that product with capable technical assistance and reliable, rapid and afforable service is a critical issue in your decision. Fluke ranks "number 3" in sales of test instrumentation worldwide. That makes us large enough to have a network of service and support facilities to fully serve our customers yet small enough to give that "extra measure" of customer care long after the sale is concluded. For over 40 years we have lived by the motto that we "... give the Customer a little bit more than he thought he paid for." Every day, all of us at Fluke work hard to ensure this motto gets translated into true customer satisfaction.

Exceptional Value

The Fluke company has built its reputation by serving customers with products of exceptional value – high performance, proven reliability and fair prices. Nowhere is this more important than in educational institutions. In the U.S., we also support the teching community with a series of Educational Discounts, Gifting Programs, and Extended Product Support plans designed specifically for education.

To see how we can effectively address YOUR teaching needs, contact your local Fluke Sales Office or representative.

**The terms GPIB/IEEE-488 may be used interchangeably throughout this catalog.*

Technical Literature Available

Application Information

Ask your Sales Office or Representative for a copy of any literature you may need. Or use a reply card, if you prefer. Please use both title and number.

Calibration

Using the 8520A DMM's Math Programs	B0075
Interpreting Specifications of Calibration Instruments	B0174
Fractional ppm traceability using your 732A	B0196
RTD Temperature Calibration System	B0197
How metrology management software simplifies MIL-STD-45662A compliance	B0204
Establishing Traceability for a High Performance AC/DC Transfer Standard	B0205
Semi-Automatic AC Verification of the 5700A Calibrator	B0211
Design and Evaluation of the 792A AC/DC Transfer Standard	B0216
Artifact Calibration: Theory and Application	B0218
Is There a Need for a Calibration Lab? (Quality 10/86)	F0062
Calibrators/Calibration Standards. Are You Confusing the Calibrator With Calibration? (EE 4/87)	F0069
Calibration Moves Out of the Laboratory (Test & Measurement World 5/87)	F0071
Beyond the Kernel (Service News 5/87)	F0075
The Life-Cycle Costing Approach to Instrument Selection (Electronic Test 4/88)	F0109
Proper Testing Minimizes IMD Analysis Errors (Microwaves & RF)	F0140
Now You Can Prove Your Quality Measures Up with the 5130A Calibrator Workstation from Fluke	G0312
Dialog 5700A Calibrator	J0321
5130A Calibration Workstation Software: Demonstration Guide	J0412

Counters

PM 6680 New Option Extends Frequency Range up to 4.5 GHz	A0482
Choosing a High Performance Timer/Counter	B0222
PM 6680 Timer/Counter: Advanced Arming-Delay by Event Counts	B0225
PM 6680 Timer/Counter: Characterizing Frequency Bursts	B0226
PM 6680 Timer/Counter: Characterizing Rapidly Changing Frequencies	B0227
PM 6680 Timer/Counter: Sources of Error in Time Interval Measurements	B0230
PM 6680 Timer/Counter: Exploring the Modulation Domain	B0231
How to Measure Signal Jitter (Electronic Products 7/92)	F0157
How to improve you counter intelligence Counter Selection Guide	G0229
Counters for the 90's	G0259
TimeView: Time and frequency analysis software for PM 6680 timer/counter	G0293
TimeView software for PM 6680 Operators manual	J0392

Data Acquisition

2400B: Intelligent Computer Front End – Software Dialog	A0202
Helios Toolbox for Basic Programmers	A0270
Labtech Notebook	A0286
Helios Software Series Software Selection Guide	A0301
D.O.E. Standards Test System for the Appliance Industry	A0412
Hydra Logger Software Package	A0426
Helios Logger Software Package	A0477
2400B: Intelligent Computer Front End Hardware	B0119
Data Acquisition Speed, Accuracy & Resolution Specifiications	B0202
Helios Plus: Using the Burst Mode to Scan Multiple Channels at 1,000 Readings Per Second	B0208
Basics of Spread Spectrum in Measurement Systems	B0239
Upgrading older installations for PC Control mandates adapting to older sensors (Personal Engineering & Instrumentation News 11/88)	F0115
Whirlpool's Never-Rest Test System (Appliance Manufacturer, 8/90)	F0137
Understanding Measurement Fundamentals Provides Confidence (Electronic Products & Technology 5/91)	F0150
Wireless Data Communications (Sensors 5/93)	F0163
Selection Guide	G0134
Data Acquisition Solutions	G0260
Hydra Data Acquisition Series Tutorial	G0306
The Fluke Wireless Logger	G0315
The Wireless Logger Tutorial	G0318
Helios-1: Case Study of Product Safety Engineering Helios 1 & Labtech Notebook	J0329

Digital Multimeters and Voltmeters

In Tune with Power Harmonics	B0221
Auto-Electric Troubleshooting: Beat the Book with Fluke Multimeters	B0164
Electrical Troubleshooting with Fluke Multimeters	B0171
The on-site Fluke story (70 Series) (Vector 5/84)	F0036
Digital Multimeter Packaging Tackles Harsh Environments (Electronic Packaging & Production 10/84)	F0045
DMM Protection Features (Computer/Electronic Service News 6/85)	F0053
Survival Tactics for Handheld Multimeters (Machine Design 1/86)	F0058
Fault Protection for digital multimeters (Electrical Construction & Maintenance 2/87)	F0066
Reliability of hand-held DMMs (Quality 12/86)	F0067
How to select a multimeter (The News 10/87)	F0102
Digital Multimeters Measure Up (Telephone Engineer & Management 3/15/90)	F0135
Testing for Harmonics: Fine-Tuning Power Lines (Electrical Contractor 7/90)	F0136
Fluke 88 Automotive Meter (Super Automotive Service 2/91)	F0143
Eye on Electronics (Motor 3/91)	F0148
The ABCs of Power Harmonics (CEE News 12/92)	F0161
The ABCs of DMMs	G0107
Guide to High Performance DMMs	G0265
C100 Universal Carryng Case	L0032
HVAC & Systems: Service Tips with Fluke Thermometers & Multimeters	L0036
Troubleshooting Electronic Engine Components	O0025
The Professional's Choice for Precision Diagnostics	O0030

Digital Test Tools

9010A/GF: Upgrade Your 9010A to Run TestWriter	A0277
9100A Testing DMA Circuitry on the IBM PC/AT®	A0350
9000/9100 Series Microprocessor Pod Adapters	A0355
9100FT Series: Emulation Selection Guide	A0467
9020A Micro-System Troubleshooter: Remote Operation	B0147
Guide to 8085 Microprocessor-Based System Testing with a 9000 Series Micro-System Troubleshooter	B0151
9100A: Testing a CGA Card with the Vector Output I/O Module	B0192
9100A/PM 3655: Developing Test Vectors for a Video Controller Chip	B0200
9100A: IEEE-488 Instrument Control Option	B0214
Small-Scale ATE Speeds the Turn On of 32-Bit Systems (Electronic Design 5/11/89)	F0121
9110FT Digital Troubleshooting	G0313
9100A: Production Testing	L0030

Technical Literature Available

Digital Thermometers

HVAC & Systems: Service Tips with Fluke Thermometers & Multimeters	L0036

LAN Products

Tools for Healthier LANs	A0493
Maybe You Need a Good Analyst (LAN Magazine 5/93)	F0164
A New Twist on Faster Easier Less Expensive LAN Cable Testing	G0309
A new faster way to stay on top of your Token Ring	G0310
The CableMeter That Works However, Whenever, Wherever Installers Work	G0316
The One-Button Anwser to Wire Mapping	G0317

Logic Analyzers

Probing: The First Challenge of Logic Analyzers	B0212
Integrated State & Timing: Fast Answers	B0213
A Logic Analyzer for Digital Repair?	B0232
True Integration of State & Timing	B0234
Logic analyzers let you use one probe set for timing & 50-MHz state analysis (EDN 10/90)	F0138
PM 3580 Family: A new concept in Logic Analysis	G0266
Clip, Flip, Run: 30 minutes to Logic Analysis	J0349
Logic Analyzer Competitive Comparison	J0351

Oscilloscopes

PM 8917 Videl Line Selector	A0305
PM 8989 Oscilloscope Carrying Case	A0359
DSO Analysis Power	A0390
TC100 Instrument Transport Cart	A0413
Test and Measurement Software for Digital Storage Oscilloscopes	A0463
Understanding DSO Bandwidth and Sampling	B0190
EBR: The Truth About Effective Bits	B0215
Oscilloscopes, Analog, Digital, or Both	B0228
Measuring Power and Energy with CombiScope instruments	B0235
Fast Frequency Measurement Analyzes Modulation and Oscillators (RF Design 5/92)	F0155
The new standard in 60 MHz and 100 MHz Oscilloscopes	G0226
Oscilloscopes Selection Guide	G0231
True four-channel 200 MHz analog oscilloscopes	G0278
100 MHz and 200 MHz four-channel combination analog/digital oscilloscopes	G0292
Digital Storage Oscilloscope Competitive Comparison	J0341
Introduction to DSOs	J0374
Scope, Probe and Measure Demo Guide	J0399
"DSOs with a Difference" Video	S0009

Power Supplies

PM 2800 Family Programmable Power Supplies	G0273

RCL Meters

Automatic RCL Meters: Component testing made easy	G0303

ScopeMeter Test Tools

Software for ScopeMeter	A0489
Triggering: Art or Science?	B0236
Autoset: How it Works	B0237
Signal Instincts: How to capture Signals with a Digital Scope	B0238
ScopeMeter (90 Series)	G0287
ScopeMeter Test Tool Accessories	G0301

Signal Sources

Programming RF Signal Generators (Test & Meassurement World)	F0156
How to make waves without getting soaked Signal Source Selection Guide	G0230
PM 5150 Arbitrary waveform generator	G0308

Service Information

Ask your local Service Center for a copy of any literature you may need. Or use a reply card, if you prefer. Please use both title and number.

Calibration and Repair Services

Calibration & Repair Services: Your Complete Resource	G0250
Calibration & Repair Services: Extended Warranty	G0261
Systems Integration Services	G0271
Calibration & Repair Services Price List	J0333

System Integration

Systems Integration Services	G0271
Appliance Manufacturing Functional Test System	B0209
RTD Temperature Calibration System	B0197

Appliance System

Appliance Manufacturing Functional Test System	B0209
Whirlpool's Never-Rest Test System (Appliance Manufacturer 8/90)	F0137

Customer Training

Customer Support Services Course Planner	O0022

Product Application Courses

MET/CAL Calibration Software Procedure Writing Workshop	E0250
Electrical Training Book	E0252

General Technology Workshops

Principles of Metrology	E0244
Calibration Lab Management	E0249
MET/CAL Course	E0250
MET/TRACK Course	In Progress

Other Literature

Periodicals

Fluke Review	P0026

Catalogs

Fluke Distributor Products	H0002
Test & Measurement (Full-line Catalog)	H0010
Electrical/HVAC-R Service Equipment	H0018

Miscellaneous

Corporate Profile	G0314
U.S. Price List	J0015
Logistics Data Book	J0019
Annual Report	J0109
Literature Log	J0353
Fluke Wholesale Distributors HVAC-R and Electrical	J0357
Test News	J0354
Professional Test Tools for Education	J0413

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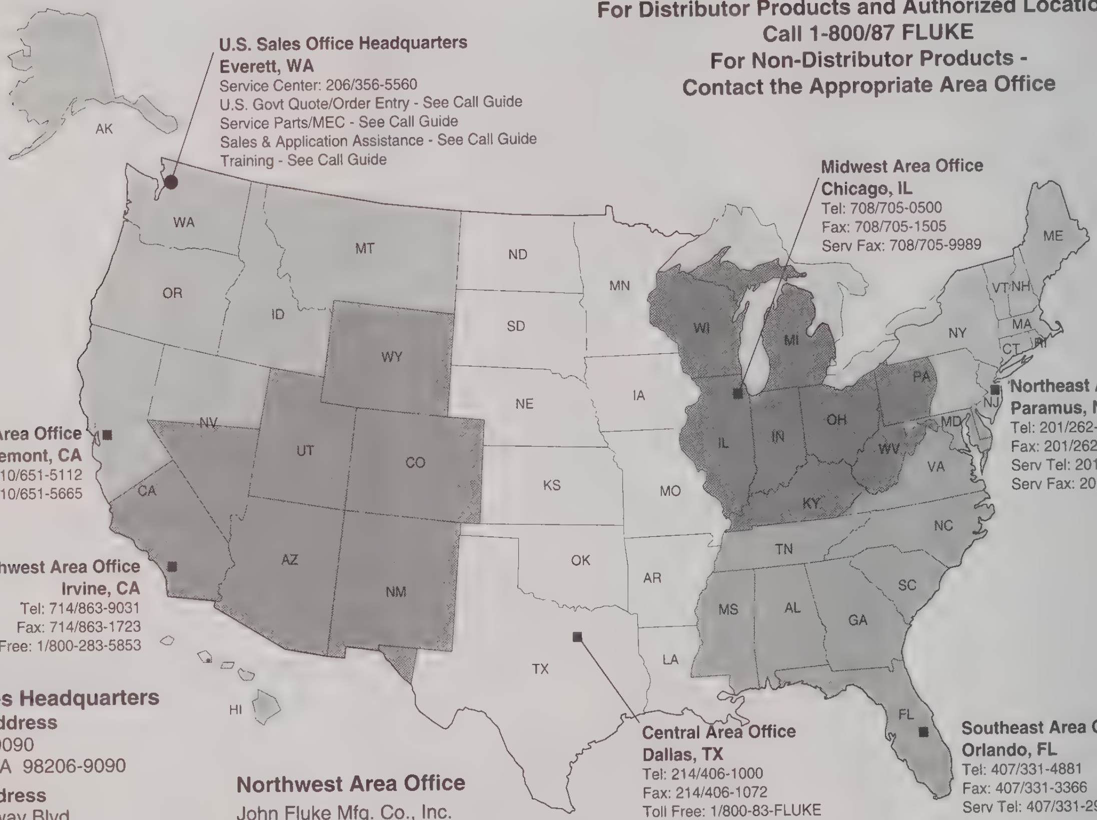
For Distributor Products and Authorized Locations -
Call 1-800/87 FLUKE
For Non-Distributor Products -
Contact the Appropriate Area Office



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Everett, WA
Service Center: 206/356-5560
U.S. Govt Quote/Order Entry - See Call Guide
Service Parts/MEC - See Call Guide
Sales & Application Assistance - See Call Guide
Training - See Call Guide

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Serv Fax: 708/705-9989

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Irvine, CA 92714
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Toll: 800/283-5853
Fax: 714/863-1723

States Covered
Arizona, California (Southern), Colorado, Nevada (Southern), New Mexico, Utah

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Palatine, IL 60067-7397
Tel: 708/705-0500 (Sales/Service)
Fax: 708/705-1505 (Sales)
Fax: 708/705-9989 (Service)

States Covered
Illinois, Indiana, Kentucky, Michigan, Ohio, Pennsylvania (Western), West Virginia

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John Fluke Mfg. Co., Inc.
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Tel: 214/406-1000 (Sales/Service)
Toll: 800/83-FLUKE
Fax: 214/406-1072

States Covered
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Fax: 201/262-0948 (Sales)
Tel: 201/599-9500 (Service)
Fax: 201/599-2093 (Service)

States Covered
Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania (Eastern), Rhode Island, Vermont

Southeast Area Office

John Fluke Mfg. Co., Inc.
550 So. Northlake Blvd.
Altamonte Springs, FL 32701
Tel: 407/331-4881 (Sales)
Tel: 407/331-2929 (Service)
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FAX: (593) 2 561980

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** For complete Fluke product range*
*** For all products except: Counters, Generators, Oscilloscopes, Logic Analyzers, Power Supplies, RCL Meters*
**** For only the following products: Counters, Generators, Oscilloscopes, Logic Analyzers, Power Supplies, RCL Meters*

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**** For only the following products: Counters, Generators, Oscilloscopes, Logic Analyzers, Power Supplies, RCL Meters*

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** For complete Fluke product range*
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